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AMERICAN
DYESTUFF REPORTER

VOLUME 25 JUNE 1, 1936 NUMBER 11

Modifications of Cellulose

By S. M. NEALE, D.Sc.*

CELLULOSE is a natural substance which serves the purpose of a backbone in plant structures, conferring upon them the necessary rigidity. It is found in a relatively pure form in bleached cotton, linen and wood-pulp, and in these forms provides the basic material for great industries.

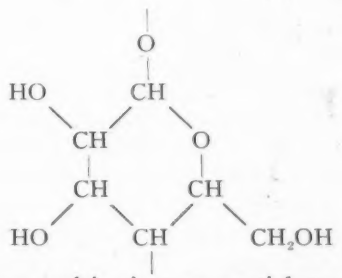
It is apparent, however, that cellulose is not a perfectly definite chemical individual—like sodium chloride, for instance—as various samples of cellulose differ widely in physical characteristics and to a less extent in chemical properties too. On this account it is not possible to define with precision the properties which justify the use of the term "cellulose." A substance is recognized as "cellulose" when it possesses certain loosely defined properties. It must be white and in its natural forms fibrous and of high tensile strength, insoluble in all ordinary solvents, and must be made up of carbon, hydrogen and oxygen in the proportion $C_6H_{10}O_5$. On treatment with strong hydrochloric acid its tensile strength must fall and the chemical properties of reducing sugars such as glucose must appear, the fibers then break up, and finally a large yield of glucose itself is obtained. On treatment with a mixture of strong nitric and sulfuric acids nitrates are formed, up to a maximum nitration corresponding to three nitro groups per $C_6H_{10}O_5$ unit. Similarly with other acids cellulose behaves like an alcohol and forms tri-esters, and with other reagents such as caustic soda and methyl sulfate forms tri-ethers such as tri-methyl cellulose.

Many different samples of cellulose satisfy these requirements.

APPROXIMATE STRUCTURE OF CELLULOSE

Athough we cannot yet define pure cellulose with precision, we nevertheless know a good deal concerning the molecular structure of this elusive material. Research work carried out in many laboratories over several decades, usually on purified cotton or ramie fibers, has brought to light many important facts.

It is now generally accepted that cellulose is built up of long chains of glucose residues and that each of these links in the chain is a molecule of glucose which has lost a molecule of water in its attachment to its neighboring links. It has also been established that this attachment—brought about by the vital processes in the plant in a manner which cannot be imitated in the laboratory—proceeds via the carbon atoms numbered 1 and 4 in the accepted glucose six atom ring. The structure of the building unit is therefore



This structure explains in a very satisfactory way the fundamental chemical and physical properties of cellulose, and has been confirmed by the use of X-ray analysis.

Certain points, which are vital to the complete solution of the problem, remain still in doubt. The exact length of the long chains has not yet been established, and although this almost certainly varies between one sample of cellulose and another it is probably of the utmost significance in determining the textile value of the specimen. The exact nature of the end groups in the terminal links of the chain is also not understood and methods for determining this are urgently awaited.

The chains of glucose residues are supposed to be arranged in roughly parallel fashion, in loosely defined bundles of unknown size. The chains themselves run either nearly parallel, or spirally at a small angle with the long axis of the fiber. Each chain is held close to its immediate neighbors in the bundle by the forces of residual valency, which operate between the hydroxy groups in adjacent positions. In certain parts of the fiber the molecular arrangement is regular and close (i.e., crystalline) so that external reagents cannot penetrate until the molecular arrangement is loosened by a reagent which brings about powerful swelling.

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Our knowledge of these matters, namely the lengths of the chains, their end groups, and the packing of the chains into bundles, is qualitative rather than precise in character.

It is probable that further advance will depend upon a closer study of the so-called modified celluloses, which are produced by mild acid hydrolysis or by oxidation of the original materials, and in whose shorter chains the greater proportion of reactive end groups facilitates the development of precise analytical methods. The methods so developed may then be used in the determination of end groups in the original "cellulose".

If it is supposed that all the chain links are identical in structure then one of the end links should possess four hydroxy groups of the normal alcoholic type, the intermediate links only three, whereas the other end link should have three alcoholic hydroxy groups and one of the reducing sugar type. In the end group method worked out by Professor Haworth and his collaborators[1] an attempt is made to determine the proportion of end groups of the first type, by converting these into tetramethyl glucose, whereas the remaining links only give rise to trimethyl glucose. In this method the sample is first fully acetylated by the action of acetic acid and acetic anhydride with traces of sulfur dioxide and chlorine as catalyst, then partially de-acetylated to the stage of easy solubility in acetone. The acetone solution is then treated with 30 per cent aqueous caustic soda and methyl sulfate, so that a fully methylated cellulose is obtained. This is now hydrolyzed by the prolonged action of cold concentrated hydrochloric acid, giving rise to tri methyl glucose with a small proportion of tetramethyl glucose corresponding to the number of end links of the first type. The mixture is converted into the corresponding tri and tetra methyl glucosides by the action of methyl alcohol in presence of hydrochloric acid, and the proportion of the tetra methyl body in the mixture is determined by solvent extraction followed by careful fractional distillation. About ½ per cent of the tetra methyl body is obtained and it is therefore concluded that the cellulose chain is approximately 200 units long, corresponding to a molecular weight of 32,000. Similar molecular weights have been found by other workers using physical methods such as osmotic pressure of nitrocellulose solutions and sedimentation in the ultra centrifuge. Other workers, however, using physical methods such as osmotic pressure, viscosity and the ultracentrifuge have deduced variable and sometimes much higher molecular weights[2].

The methylation method is open to several objections. It is very laborious and the possibility that the reagents effect some separation of the links before the end of the methylation stage, thereby increasing the proportion of end links, cannot be altogether excluded without rigorous proof, in view of the ease with which this change takes place. It might be considered that the estimation of the other end link, which should possess the characteristic reducing sugar properties, would be an easier matter. The reducing sugar group is supposed to react quantitatively with sodium hypoidite under controlled conditions, but although this method is successful in the case of glucose itself, its application to cellulose has not yet received the precise and detailed study necessary for its establishment or rejection on a secure basis.

The reducing sugar group also precipitates cuprous oxide when heated with a mixture of cupric sulfate and sodium carbonate and bicarbonate. This seems to offer a hopeful method, but although the reaction has been carefully investigated its precise course is not at all clear. Glucose itself gives several different oxidation products in this reaction, and moreover the amount of copper reduced is not proportional to the amount of glucose present. These defects seem to rule out the method as a precise means of determining the reducing end group, but it has the great merits of specificity, sensitivity, and convenience, and Farrow, Richardson and Higginbotham[3] have recently shown that by a slightly modified procedure a linear relation between the amount of reducing sugar and the amount of copper reduced may be obtained. They have applied this method to the study of starch and conclude that chemically unmodified starch has a glucose chain containing about 1,000 units, in approximate agreement with the results obtained by other workers using physical methods. This is in sharp contrast to the result obtained by the methylation method for starch, namely 30 glucose units, and Richardson suggests that in the methylation method some unavoidable breakdown occurs. The application of Richardson's method to cellulose will be awaited with interest. Starch and cellulose are structurally very similar but in starch the linking of the glucose units is spatially different, so that curved instead of straight chains result.

REACTIVE END GROUPS IN MODIFIED CELLULOSES

When cellulose is treated with aqueous solutions of acids a continuous change takes place in which the tensile strength and viscosity in solution fall steadily, while the power of reducing copper, negligible at first, steadily increases. There is a definite but empirical relation between the rise of reducing power, measured by the "copper number" and the fall in viscosity[4]. It is almost certain that in this process the chain linkages are gradually separated by hydrolysis, with the production of reducing sugar groups on half of the new end linkages. The resulting "hydrocelluloses" therefore offer suitable materials for the determination of the reducing sugar end group in cellulose. Such determination has not yet been effected however. The copper number gives a precise but empirical figure, while the revised method of Richardson has not yet been applied to these materials.

[1]Haworth and Machemer, J. Chem. Soc., 1932, p. 2270.
[2]See e.g. Kraemer and Lansing, J. Phys. Chem., 1935, *39*, 153.
[3]Shirley Institute Memoirs, 1935, *14*, 63.
[4]Birtwell Clibbens & Geake, Shirley Institute Memoirs, 1926, *5*, 37.

Cellulose may be slightly oxidized by a variety of reagents, such as caustic soda and oxygen, hypochlorite, hypobromite, permangate and acid bichromate. There results a very complex series of "oxycelluloses", whose properties have been closely studied by Clibbens and his collaborators[5]. They have shown that oxidation, like hydrolysis, is accompanied by progressive fall in tensile strength and viscosity and rise of copper number. At the same time new characteristics indicative of acidic properties, such as the power of strongly retaining basic dyestuffs, begin to appear. In some "oxycelluloses" the reducing properties are strongly marked, in others the acidic properties, and their relative proportions varies with the nature of the oxidant and the pH of the solution, the acidic properties being most marked after alkaline oxidation.

The structure of these oxidized celluloses is undoubtedly complex, and indeed the oxidation of simpler bodies such as glucose and mannitol is not yet fully investigated in respect to its bearing on this problem. It is reasonable to suppose however, that the acidic group is simply a carboxylic acid group. Schmidt[6] has attempted to determine this group in cellulose by a conductimetric titration and finds a constant value of 0.28 per cent CO_2 for all forms of cellulose. This result—at least the constancy of the figure—seems improbable. The author has repeated Schmidt's method and finds no inflexions on the titration curve sufficiently sharp to be susceptible of other than subjective interpretation. Lüdtke[7] claims to determine the carboxylic acid group by treating cellulose after acid and water washing with calcium acetate solution, followed by titration of the liberated acetic acid in presence of phenol phthalein. The author has also tried this method, but finds that the buffering action of the acetate is so strong that an extremely vague end point, incapable of accurate estimation, is obtained. It has been shown[8], however, that when acid washed oxidized cellulose is treated with sodium chloride solution, an interchange of ions takes place, resulting in the liberation of hydrochloric acid. By the mere addition of common salt, followed by a slight excess of dilute alkali and back titration with N/100 acid in presence of the cellulose, using an indicator turning at pH 6, a very sharp result can be obtained. It may be presumed that this method offers a reasonable hope of the quantitative determination of the COOH group. Bleached cotton and hydrocelluloses give vanishingly small figures, while oxidized cottons give acidities which rise with the degree of oxidation. In the case of alkaline hypobromite oxidation, about five atoms of oxygen give rise to one COOH group. This method is being developed. It is hoped that it will also prove useful in the study of the simpler "hydrocelluloses", since if the reducing sugar group can be oxidized to a gluconic acid group by a suitable reagent the proportion of the former can be deduced.

[5]Birtwell Clibbens & Ridge, Shirley Institute Memoirs, 1924, *3*, 321.
[6]Berichte, 1934, *67*, 2037.
[7]Papier Fabrikant, 1934, *32*, Parts 49 and 51.
[8]Neale, Nature, 1935, *135*, 583.

Some Technical Aspects of

Vat Color Printing*

By I. F. CHAMBERS†

THE era of modern vat color printing may be said to date from the momentous discovery of sodium sulfoxylate formaldehyde by Baumann, Thesmar, and Frossard in 1902. At the same time, vat color agers were improved to a remarkable extent and the successful application of vat colors by printing methods became an accomplished fact. Many modifications and refinements have been introduced in the last thirty years but the principles set forth by these early investigators are in constant use today.

The introduction of synthetic fibers and the demand for new and unique effects have contributed to the increasing complexity of the printing operation in recent years. The printer is confronted with intricate patterns, sheer and heavy fabrics composed of natural or synthetic fibers and stringent specifications as to brilliancy, penetration, and levelness of the finished print. In order to cope with these conditions it is necessary for the printer to possess a fund of practical information and a clear conception of the fundamental principles involved in the printing operation.

Vat color printing by the sodium sulfoxylate formaldehyde method may be tentatively divided into three general classes or styles:

Direct or Application Printing.
Discharge Printing.
Resist Printing.

Direct or application printing is fundamentally the least complicated of the styles mentioned and consists in applying the vat color to an undyed fabric.

Discharge printing refers to printing on a fabric which has been dyed with a dischargeable azo color, a vat color design or an azo color ground being obtained.

In resist printing, the vat color is resisted or prevented from fixing on local areas, the effect being somewhat

*Presented at meeting, Textile Printing Colorists Guild, Inc., Paterson, N. J., May 16, 1936.
†E. I. du Pont de Nemours & Co., Inc.

analogous to a white discharge on a vat color ground. This process is relatively unimportant as compared with direct and discharge printing.

Vat colors for printing purposes are very finely dispersed organic pigments prepared in both paste and powder form. Recent work on the measurement of particle size of vat color pigments suitable for printing has shown that the individual particle is very small indeed. In certain types of color pastes, the particle size varies from 0.2 micron to 1 micron in diameter while in others the particles are comparatively much larger, varying from 2 to 15 microns. Since a micron is equivalent to $\frac{1}{1000}$ of a millimeter or about $\frac{4}{100{,}000}$ of an inch, it may be seen that a typical vat color paste consists of dispersed particles of colloidal proportions.

Colloidal dispersions are subject to flocculation under certain conditions by the presence of electrolytes and the occasional specking which is sometimes observed when a vat color paste is suddenly brought into contact with a printing gum may be explained on this basis. Vat color pastes have been improved in physical properties to such an extent that specking is a rare occurrence but if difficulty is encountered from this source it may be obviated in a large majority of instances by mixing a small percentage of glycerine or neutral gum such as tragacanth with the color before incorporating it in the alkaline printing gum or by slowly incorporating the alkaline printing gum into the color paste. A careful control in mixing color with the printing gum will more than repay the color mixer in obtaining printing pastes in which the vat color particles are excellently dispersed. A simple and effective test for dispersion consists in placing a small quantity of the printing paste between two glass plates which are pressed together so that the film of printing paste may be viewed against a source of bright light. Any faults in dispersion are immediately detected and the necessary corrections may be applied at once.

It is often advisable to prepare or condition the goods before printing. This is particularly true in the case of very tightly twisted rayons or of delustered rayons.

The general process for delustering consists in introducing into the viscose solution prior to spinning insoluble organic or inorganic materials of high refractive index. The particle size of the delustering agent may vary from 0.5 to 5 microns which as we have seen is comparable to the particle size of vat color pigments employed in printing.

Although the delustrant is present in relatively small percentages, average values being 2 to 6 per cent on the weight of the yarn, the delustered material exhibits marked changes in both optical and printing properties. Depending on the character and percentage of delusterant present in the fiber, a print on delustered rayon may exhibit many undesirable characteristics such as poor color value, lack of penetration, and a specky or mottled appearance. Delustered rayon is rapidly becoming an extremely important textile commodity however, and it is the task of the printer to modify the processing of this material to meet the approval of the consumer.

The physical characteristics of certain types of delustered rayon may be noticeably improved for printing purposes by padding with a hygroscopic agent such as glycerine. This operation is conveniently carried out with a two or three roll quetsch followed by drying on a tenter frame. The presence of glycerine permits the particles of delusterant to be wet out more readily by the printing composition and generally increases the adsorptive properties of the fabric. This treatment is also of value for sheer rayon materials which are fragile and subject to breaking by the mechanical abrasion of the printing process.

Cotton and rayon piece goods that have been previously dyed with azo colors for vat color discharges are often advantageously prepared for printing by padding with a dilute solution of meta nitro benzene sodium sulfonate. In the case of rayons, the pad liquor may also contain glycerine thus combining two operations. Certain azo colors, particularly in the range of greens and browns are very readily discharged by sodium sulfoxylate formaldehyde and this property, while very desirable from the discharge point of view, often induces a difficulty in the printing operation known as "facing." A printing machine of the usual design unfortunately suffers from certain inherent mechanical defects. The function of the doctor blade is to remove all traces of printing paste from the portions of the printing roll which are not engraved but in practice it may be seen that a thin film of printing paste slips under the doctor blade and is deposited on the fabric. This film of printing paste ordinarily has no adverse effect but in certain instances, a partial discharge of the ground shade is obtained over the entire surface of the fabric. This may be readily observed by comparing the face with the reverse side of the fabric, a very noticeable difference in strength and brilliancy being seen if "facing" has taken place to any appreciable extent.

The protective action of para nitro benzene sodium sulfonate is due to its mild oxidizing properties. The relatively small amount of sodium sulfoxylate formaldehyde which has been deposited on the fabric by "facing" is rendered inert by immediate oxidation. An alternative method consists in applying the oxidizing agent to the goods immediately after printing the vat colors rather than before printing. This is usually carried out by over-printing or cover-printing the goods with a roller engraved with a cross-hatch pattern, the printing paste consisting of a neutral gum containing an oxidizing agent such as para nitro benzene sodium sulfonate or hydrogen peroxide. The efficiency of the latter method is sometimes impaired, however, by the fact that the ground shade may be partially discharged by the reducing agent while drying and before protective measures can be carried out. Under such con-

ditions, the damage has been done and further treatment is without effect.

The principles involved in eliminating "facing" have been applied to resist printing with vat colors. In this case, a printing paste containing a high concentration of oxidizing agent is applied to the fabric by the first roll of the printing machine, while the vat color is over-all or cover-printed by the second roll. The vat color is resisted in local areas according to the engraving of the first roll, the final effect resembling a white discharge on a vat color ground.

A vat color printing paste, reduced to its essential components, is a suspension of vat color particles in a colloidal vehicle such as a starch or gum paste in which has been dissolved an alkali metal carbonate, sodium sulfoxylate formaldehyde and a small percentage of glycerine. The physical characteristics of the printing paste are dependent in a large measure on the starches or gums employed as thickening agents. The adaptability of a thickening agent for a particular purpose is largely a matter of experience. This is due in part to the difficulty in classifying the physical properties of a printing paste in adequate scientific terminology and also to the multitude of variables which influence the choice of a thickening agent. Among the factors to be considered in choosing a starch or gum may be mentioned the following:

Color yield.
Brilliancy of shade obtained.
Penetration of color to the reverse side of the fabric.
Levelness of print.
Sharpness of design.
Working properties in color box of printing machine.
Ease of removal from fabric.
Thickening power.
Type of engraving on printing roll.
Nature and construction of fabric to be printed.
Cost.

From the above, it may be seen that certain of the factors apply directly to the color or printing paste while others which are equally important, have only an indirect significance.

The printer may compound the starch or gum thickeners in the color shop or purchase prepared thickeners which have special properties and are recommended for special uses. It is not within the scope of this paper to discuss prepared thickeners, although many excellent products are on the market.

There are certain characteristics associated with the common starches and gums which serve as a guide to the printer for preparing printing pastes in the color shop. The starches such as wheat starch, corn starch and tapioca starch in general produce good tinctorial value and are very extensively employed for cotton printing. For rayons, it is advantageous to employ converted starches such as British gum or dextrin as these products produce very sharp outlines and are readily removed from the fabric allowing a soft finish to be obtained. It is common practice to employ wheat starch and British gum together in various proportions, a much higher percentage of starch being used for cotton goods than for rayons. Gum tragacanth is a valuable thickening agent for use with starch or British gum as it is easily removed from the fabric, and is of great value in securing penetration. The natural gums such as Senegal, Arabic, Karaya, and Shiraz, in general yield level prints with sharp outlines but are somewhat inferior to starch in color value.

The presence of an alkali metal carbonate is necessary in a vat color printing paste in order to solubilize the vat color during reduction in the ager to its leuco form.

Potassium carbonate is most commonly employed as it is very soluble, a desirable property in preparing concentrated printing pastes. Potassium carbonate is also quite hygroscopic and aids in condensing moisture on the print during ageing. Sodium carbonate is less expensive than potassium carbonate but is also less soluble and is not as hygroscopic. Many mills, in the interests of economy, employ potassium carbonate for heavy shades and sodium carbonate for medium and light shades.

Sodium sulfoxylate formaldehyde is universally employed as a reducing agent in vat color printing. The commercial product is practically 100 per cent pure and is available in powder, pea size, or lump form. Various attempts have been made to improve the characteristics of this product by substituting other aldehydes for formaldehyde but to date the results have been unsuccessful. Sodium sulfoxylate formaldehyde owes its valuable properties to the fact that it is stable and relatively inert at room temperatures but at the temperature of the ager its strongly reducing power becomes apparent.

The amount of sodium sulfoxylate formaldehyde to be added to the printing paste for direct printing depends on the depth of shade printed and the efficiency of the local ager. In discharge printing a somewhat larger quantity of reducing agent is employed as it is necessary to discharge the ground shade in addition to reducing the vat color. A large excess of reducing agent is to be avoided in discharge printing as a halo or white ring is apt to form on the border of the vat color design. Goods which have been prepared with a mild oxidizing agent are less susceptible to halo formation than untreated materials.

Glycerine is added to the printing paste on account of its hygroscopic properties and also because it exerts a solubilizing action on the leuco derivative of the vat color and thus assists fixation. The amount to be employed is dependent on the type of fabric to be printed and the local ageing conditions. An excess of glycerine may also induce halo formation or marking off of the color in the ager.

Auxiliary ingredients or assistants are often added to the vat color printing paste in order to improve the color value, working properties, or to obtain special effects. These products may be generally classified as follows:

1. Catalytic agents.
2. Solvents.
3. Hydrotropic agents.

4. Penetrating agents.
5. Lubricants.

Catalytic agents are substances which increase the velocity of reduction of the color in the ager. These compounds include anthraquinone or its soluble derivatives and inorganic salts whose cation is capable of existing in two states of valency. Catalysts of this type are principally effective with colors of the indigoid and thioindigoid series.

Solvents are water miscible organic liquids whose function is to promote the solution of the leuco derivative of the vat color upon reduction in the ager. Glycerine and other poly hydroxy alcohols are typical solvents. Although glycerine is normally considered to be a valuable adjunct to the printing paste on account of its hygroscopic properties, it also possesses a definite solvent action on the leuco derivative.

Hydrotropic agents are somewhat similar to solvents in that they promote solubility of the leuco compound but differ in that they are usually salts, sodium benzyl sulfanilate and tetrahydronaphthalene sodium sulfonate being typical examples. It is rather curious to conceive of the phenomenon of adding a neutral salt or hydrotropic agent to a printing paste in order to increase the solubility of another salt, i.e., the leuco derivative of the vat color, but this is the generally accepted theory of hydrotropic agents.

Penetrating agents are added to the printing paste in order to increase penetration of the color into the fiber. The effect of a penetrating agent may be readily observed by examining the reverse side of the printed fabric. If the reverse side of the print is practically as strong as the face, the penetration may be considered to be excellent. Materials such as turpentine and pine oil have been used to increase the penetration of the color. For this purpose, there are also a number of proprietary products on the market which are quite effective. These products are apparently surface active materials and reduce the interfacial tension between fabric and printing composition.

A lubricant may be considered to be any substance which imparts improved working properties to the printing paste. A small percentage of light mineral oil is currently employed as a lubricant and is of distinct value in reducing scumming of the printing roll and in preventing "sticking in" of the color in the engraving. Stearic acid is often added in small percentages to a gum during the cooking process. The stearic acid undoubtedly reacts with the alkali present to form a soap which acts as a lubricant and dispersing agent.

The characterization of printing pastes by the determination of physical constants such as viscosity, thixotropy, and surface tension would be of inestimable value in advancing our knowledge of the properties of a printing paste which are desirable for a particular purpose. Fortunately, investigations of this nature are being carried out by various research associations, an interesting example being the recent work of S. N. Glarum (cf. American Dyestuff Reporter, Vol. 25, p. 150, March, 1936) on the correlation of flowing properties and printing qualities of vat color printing pastes. This work is not yet complete but sufficient information has been obtained to indicate that in the near future it will be possible to completely identify vat color printing pastes in absolute physical terms.

The deposition of the color on the fabric by the printing machine is a mechanical operation which requires very careful control. It is at this point that a high degree of correlation between engraving of the roll, viscosity of the printing paste, and adjustment of the doctor blade is required. These factors are in turn dependent on the pattern, the type of fabric to be printed, and the particular effects desired. The type and depth of engraving is of particular importance in printing delustered rayon. In general, a fine engraving produces noticeably more uniform prints than a coarse engraving on this class of material. The penetration of color to the reverse side of the fabric is naturally much less with a fine engraving with the result that an average value is usually chosen. Chromium plated rolls are becoming increasingly popular for printing both cotton and rayon and are of especial value when large yardages of material are to be processed. A chromium plated roll does not scratch readily and permits a much greater pressure to be placed on the doctor blade without ripping the engraving than a copper roll. Many mills find that freedom from scratching, scumming, and delays in printing machine operation justify the extra expense of chromium plating.

The ageing of a vat color print may be considered to be one of the most critical points in the printing procedure. The vat color is reduced to its soluble or leuco form in the ager permitting the color to penetrate and dye the fabric. The condition of the ager determines to a large degree the percentage of color fixed on the fiber and the brilliancy of the print.

The first development of a vat color ager as we know it today was very probably the ager developed by Schlieper and Baum in 1883 for printing indigo by the glucose-caustic soda process. These early printers realized the importance of excluding air from the ager and recommended conditioning the steam by passing through water in the bottom of the ager. These principles are in use today in the construction of modern agers.

Stated broadly, ageing consists in exposing a vat color print to an atmosphere of steam for about five minutes. Five minutes is mentioned as a nominal figure as in certain localities the ageing time is reduced to 3¼ or 3½ minutes while a 10 or 15 minute ageing is not uncommon, especially in European countries.

The control of an ager in order to obtain maximum strength and brilliancy of print with uniform production is extremely difficult. While we can only speculate as to what actually takes place within an ager, a review of the probable reactions places us in a more favorable position for determining methods of control. As the printed material passes the throat of the ager and comes in contact with

the steam present, the fabric is quickly raised to steam temperature. Since the temperature of the steam in the immediate vicinity of the fabric is lowered by contact with the relatively cold fabric, condensation takes place furnishing the very necessary moisture which allows the dyestuff to dye the fabric. Simultaneously with the increase in temperature of the fabric, the sodium sulfoxylate formaldehyde becomes active, reducing the vat dyestuff and releasing formaldehyde vapors. Water is condensed on the entire surface of the fabric but more especially on the printed areas due to the presence of hygroscopic agents such as potash, glycerine, and the printing gums. Condensation of water on the fabric is particularly great near the entrance of the ager as the first rolls always show the greatest accumulation of dyestuff and the danger of marking off is greatest at this point. As the cloth progresses through the ager an apparently ambiguous condition develops, that is, the temperature of the cloth becomes higher than the surrounding steam temperature. Various investigators have reported that on certain occasions, a thermometer thrust in the interior of an ager will register 25 to 30 degrees higher than thermometers placed at the sides. In other words, the relative situations between steam and fabric are reversed; instead of the steam heating the fabric, the fabric tends to heat the steam but unfortunately for ager control a fabric is not a very efficient type of radiator and a stalemate condition develops which is very difficult to correct.

The source of this heat is principally the heat liberated by steam in passing from the vapor phase to the liquid phase. Upon condensation of one pound of steam at atmospheric pressure to water at the same temperature, approximately 970 British Thermal Units of heat are liberated.

Other contributory heat factors on which, however, we have little experimental data under actual ageing conditions, are the heat of adsorption of cellulose, the heat of solution of the salts present on the printed areas, and the heat liberated or adsorbed by the reduction of the vat color to its leuco form. It is probable that, in any case, the heat involved in these reactions is of small magnitude in comparison with the heat liberated by the condensation of steam.

While it may readily be appreciated how the fabric may become exceedingly warm by the condensation and adsorption of water from the atmosphere of steam, it is not so evident why an equivalent cooling effect should not take place by the reversal of the process or the evaporation of water from the fabric. Since the pressure within the ager is only very slightly above atmospheric pressure, evaporation of water from a fabric at 230° F. or 240° F. should be rapid. This evaporation very probably does take place to a considerable extent from the unprinted portions of the fabric but on the printed areas a very different situation exists. The water present is very probably saturated with dissolved salts, in which case the boiling point would be materially raised. The film of printing gum may become quite dry and dense on the surface thus retarding evaporation. Water is also not easily removed from hygroscopic agents. In certain instances, it is necessary to heat solutions of hygroscopic agents under a vacuum in order to obtain the dry product in a reasonable length of time.

Conditions are also very unfavorable for cooling the cloth by the circulation of steam. Due to the manner in which the fabric is plaited in the ager, steam pockets very readily form between the folds of cloth and the steam is trapped in these spaces. A gas is at best a very inefficient cooling medium and under ager conditions particularly so, since the temperature differences are relatively small from a heat transfer point of view and the overall coefficient of heat transfer is very low from a solid such as cellulose which has poor heat conductivity to a gas. Since gas velocity is an important variable in the overall coefficient of heat transfer, it is advantageous to circulate the steam by means of fans or admit a large volume of steam into the ager.

Up to the present time, very little fundamental work has been carried out on the reactions taking place within an ager and successful ager control is therefore largely a matter of experience. The most effective method for controlling an ager in order to obtain consistently satisfactory results is still a subject of much controversy. However, there are a few general principles to which a large majority of printers subscribe and which may be enumerated as follows:

(a) The ager temperature should be maintained at slightly above 212° F. in order to secure maximum strength and brilliancy of the print. Due to practical considerations, agers are often run at 218° F. to 220° F. as the danger of marking off of the printing paste or of flushing of the print is less at the higher temperature. Every effort should be made, however, to age at a lower temperature as laboratory tests and plant experience have demonstrated that high ageing temperatures are not conducive to satisfactory results.

(b) A sufficient quantity of steam should be admitted to the ager to secure circulation between the folds of the cloth and throughout the ager. Agers are usually provided with ventilators or exhaust fans in order that a considerable volume of steam may be employed without an excessive quantity issuing from the throat. Good circulation of steam is of value in controlling the temperature of the ager and in removing the formaldehyde vapors resulting from the decomposition of the sodium sulfoxylate formaldehyde in the printing paste. An adequate supply of steam is also excellent insurance for preventing the entrainment of air and the formation of air pockets.

(c) If there is any possibility of the entering steam containing an appreciable amount of superheat, the steam should be conditioned before use. There are several methods of accomplishing this such as passing the steam through boiling water or by introducing a fine stream of water in the steam line. The principle is the same in all

cases, however, the superheat being removed by the vaporization of additional water to steam.

After ageing, the printed material is treated with an oxidizing bath in order to convert the soluble leuco derivative of the vat color into the insoluble or pigment form. The oxidizing bath may be simply cold running water which of course contains dissolved oxygen or a dilute solution of mild oxidizing agents such as sodium bichromate, sodium perborate, ammonium persulfate or hydrogen peroxide. The oxidizing bath is generally acidified with acetic acid in order to neutralize the carbonate in the print. Cotton prints are usually oxidized in the open width soaper as they possess sufficient tensile strength when wet for processing on this type of equipment. Rayons, unless of heavy weave or mixed with cotton are very liable to be damaged on an open width soaper and are treated in becks.

The soaping of the oxidized print removes the gums and unfixed color particles and materially brightens the shade of the vat color. Depending on the character of the fabric, the soaping operation may be carried out in the open width or in the rope form. In recent years the higher alcohol sulfates have been extensively employed for soaping, particularly on rayon fabrics. The alcohol sulfate is not entirely rinsed out of the fabric and forms a base for later finishing operations.

The question of overall printing efficiency or the percentage of vat color actually fixed on the fiber has always been of interest to printers. Unfortunately, there is very little data to be found in the literature on this very interesting subject as the investigator has to devise his own analytical procedures. In an unpublished laboratory investigation, analyses were made on typical laboratory prints of various types of vat colors. The results showed an average of 65 to 75 per cent fixation from which it may be readily concluded that the printing operation is open to considerable improvement in the matter of efficiency. A rapid method of analysis to serve as a check in printing efficiency would be of great value to printers and may possibly be worked out in the future.

—♦♦—

Recent Developments in the

Weighting of Silk*

Some Details of the Modern Tendency to Replace Tin by Other Metals

TIN-WEIGHTED real silk is generally recognized as having inferior wearing properties as compared with ordinary degummed silk and this is especially the case when the weighting is carried to high limits. This inferiority remains in spite of many suggested methods for adding substances to the weighted silk, for example, urea, for which it is claimed that they have a protective influence. It thus seems that the presence of tin-weighting substances in silk is directly responsible for its decreased durability, and for this reason recent progress in silk weighting appears to lie in the discovery of methods for achieving the same result, using metals other than tin, it having been found that such other metals are less destructive towards the silk.

COVERING POWER

Before considering the newer methods in which such metals as zinc, cadmium, and lead are employed it should be pointed out that the term weighting does not indicate fully the changes which occur in the silk subjected to weighting processes. Not only does weighting serve to make good the loss of about 25 per cent which occurs in degumming and also to increase the weight of the silk much beyond that of its original non-degummed state, but it also has the important effect of increasing the diameter of each silk fiber and so giving it a much greater covering power. This last-named effect is often quite as important as the weighting itself.

Experience has shown that successive treatments of silk with solutions of stannic chloride, sodium phosphate, and sodium silicate have the effect of adding both weight and volume to the silk fibers without reducing substantially their softness of handle. Hence this is the most used method of weighting silk. It is just unfortunate that the presence of these tin compounds make the silk particularly susceptible to the deteriorating influence of sunlight so that accelerated oxidation of the silk substance (fibroine) takes place with consequent loss of tensile strength. Those interested in this aspect of silk weighting should refer to a paper by M. Harris on the photochemical decomposition of tin-weighted silk (AMERICAN DYESTUFF REPORTER, 1934, 23, 403) where considerable evidence is collected to

(Continued on page 304)

*Textile Mercury and Argus.

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

JUNE 1, 1936

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Members should notify the **Secretary** immediately of all address changes

REPORT, NORTH CAROLINA STATE COLLEGE SECTION

IN the week ending April 11th, Mr. Ben Verity, Technical Adviser to the Carbic Color & Chemical Co., and Councilor of the Association from Rhode Island, was the guest of the Section, speaking several times and demonstrating several processes of dyeing and printing, especially with dyes of the Indigosol type.

More recently Mr. C. W. Gilchrist, Secretary-Treasurer of the Charlotte Chemical Laboratories, spoke on "Calgon and Water Treatment", describing the preparation and uses of this product, and showing experiments.

Respectfully submitted,

JAMES W. FURR, *Secretary*

MEETING, MID-WEST SECTION

THE Spring Meeting of the Mid-West Section of the American Association of Textile Chemists and Colorists was held on Saturday, May 2nd, at The House on the Roof, Hotel Sherman, Chicago, Illinois. Reception at 6:00 P.M., was followed by Dinner at 7:00 P.M.

The meeting was called to order by Chairman Arthur T. Brainerd at 8:30 P.M. Minutes of previous meeting were read and approved. Chairman Brainerd complimented the new Sectional Committee on the results achieved to date in obtaining of new memberships.

Mr. George Warburton then officially invited the Section to holds its next Outing at Oshkosh, Wisconsin, and on a vote, the invitation was accepted for Saturday, June 20th. Chairman Brainerd appointed the following members to constitute the Outing Committee:

Mr. George Warburton, Mr. Gerry Kremers, Mr. Herbert Tetzlaff, Mr. J. G. Stott.

The meeting was then addressed by Dr. William D. McNally, prominent Toxicologist and former Coroner's Chemist, on the subject, "The Chemist as an Aid in the Detection of Crime." Dr. Dollert, Pathologist, of Milwaukee, made some remarks on conclusion of Dr. McNally's address.

Seventy-five members and their guests attended the meeting.

There being no further business, the meeting was adjourned at 10:25 P.M.

Respectfully submitted,

E. A. JOHNSON, *Secretary*.

The Determination of Wool in Wool-Cotton Textile Materials*

By BERTIL A. RYBERG†

INTRODUCTION

THE Research Committee of the A.A.T.C.C. has felt the need for an improved method for the determination of wool in wool-cotton textile materials. The purpose of the work reported here was to review existing methods and to make a further study of the problem which would lead to the establishment of a more reliable method.

The usual method of analysis of wool-cotton materials has been by treatment with hot caustic solution. This treatment dissolves the wool. The residue of cotton is weighed, a correction factor added, and the wool determined by difference. This method has the advantages of simplicity, speed, and long established usage. It has the inherent drawback of the indirect method, that is, the wool, the more valuable and important component of the material, is determined by difference. It has the further disadvantage that a variable and somewhat uncertain correction factor must be applied to the weight of the cotton.

Other general methods which have been proposed for the determination of wool in wool-cotton materials are as follows:

(1) Solution of the cotton by means of moderately concentrated sulfuric acid of a specified strength and weighing of the wool residue. This method has been described by several workers, notably Villavecchia and Hannan[1], Villavecchia and Capelli[2], Heerman[3], Lloyd and Priestly[4], Schulze[5], Krais and Markert[6], and Griffin[7].

(2) Carbonizing of the sample by means of a treatment with a solution of aluminium chloride and heating in an oven. This method has been the subject of a study by Mease and Jessup[8].

The latter method depends upon the mechanical separation of the carbonized cotton from the wool fibers by rubbing the carbonized sample against a screen. This method has not given accurate or consistent results in the laboratories of the members of the sub-committee. It has the further disadvantage of being irritating to the hands, nose, and lungs of the operator.

(3) Estimation of the amount of wool by determination of the nitrogen content of the wool-cotton material, using the Kjeldahl method, as proposed by Ruskowski and Schmidt[9].

It is significant that the majority of investigators in this field propose the use of sulfuric acid for the separation of wool from cotton.

After a preliminary investigation of the caustic boil method, aluminium chloride method, and proposed sulfuric acid methods, the sub-committee and Associate felt that the use of sulfuric acid and the Kjeldahl nitrogen determination method as a means for determining wool, should be further investigated. The work here described has been carried out along these lines.

PROPOSED METHOD FOR THE DETERMINATION OF WOOL IN WOOL-COTTON TEXTILE MATERIALS

The method finally developed is based upon treatment of the sample in a 1 per cent solution of sulfuric acid at the boil followed by a further treatment in a 70 per cent solution of sulfuric acid at 100° F. The method in detail is as follows:—

Samples may be prepared by extracting for two hours using carbon tetrachloride, followed by washing in warm distilled water. Such a preparation is sufficient for routine work. If non-fibrous materials are present which are not removed by this treatment, they should be removed by appropriate methods. (See Yearbook of the A.A.T.C.C. page 130, 1934). Tightly woven, knit or felted fabrics should be cut into ⅛ to ¼ inch strips. Highly twisted yarns should be partly untwisted.

Approximately two grams of the prepared sample are dried to constant weight. (105°C.-110°C.). The weighed sample is then immersed in 200 ml. of a boiling 1 per cent solution* of sulfuric acid for 7-10 minutes.

If the sample is cloth or yarn, it is transferred to a gooch crucible (no asbestos) and the excess acid is removed by suction. If it is in the form of loose fiber, it is collected in a crucible with a medium fritted glass bottom and the excess acid is removed by suction. The sample is then placed in 200 ml. of a 70 per cent solution*

*This research project has been made possible through an allocation from the Textile Foundation.

†Research Associate of the American Association of Textile Chemists & Colorists, working at the Lowell Textile Institute, under the direction of the Sub-Committee on the Determination of Fibers in Mixtures, Claxton Munro‡, Chairman, Herman Boxer, Hugh Christison, Leslie Christison, John N. Dalton, Roland E. Derby, Harold W. Leitch, Alex Morrison (acting chairman), Clarence L. Nutting, Louis A. Olney and John H. Skinkle.

‡Deceased since preparation of this paper.

*The solutions of sulfuric acid used should be carefully made up to contain 1% and 70% respectively, of actual sulfuric acid, by weight.

TABLE I

Comparative Analyses by Cooperating Laboratories

Material	*Associate*		*Am. Woolen Co.*		*M. T. Stevens*		*Pacific Mills*		*Arlington Mills*	
	H_2SO_4	KOH	H_2SO_4	KOH	H_2SO_4	KOH	H_2SO_4	KOH	H_2SO_4	KOH
Merino A	78.7	21.7	78.7	21.9	78.4		78.7	21.7	79.2	
Merino B	21.1	79.1	21.2	79.3	21.2		21.0	79.4	21.2	
Union	66.7	33.5	66.5	33.7	66.4		67.2	34.0	67.3	
Shoddy H_2SO_4 Carb.	98.8	1.0	98.8	0.4	98.8		98.0	0.6	98.4	1.3
Shoddy HCl Carb.	99.9	0.1	99.1	0.2	99.5		98.6	0.1	98.5	0.4
Fine Top	100.8		100.9		101.2		100.7		100.2	
Coarse Top	100.6		100.6		100.8		100.7		101.1	

H_2SO_4= % Wool by the sulfuric acid method.
KOH=% Cotton by the caustic boil method with a factor of 1.03 for correction.

of sulfuric acid at 100° F, and worked 15 minutes. It is collected on a 100 mesh screen or in a crucible with a fritted glass bottom and washed well with cold water, then placed in a beaker and neutralized with a 2 per cent solution of sodium bicarbonate at room temperature for 5 minutes. It is washed again on the screen or in the crucible, oven dried and weighed. This method has been tested in five co-operating laboratories. The results obtained are given in Table I.

MATERIALS USED IN THE PROJECT

Merino fabrics A and B. These were specially made for the project from cotton and wool combed together. Fabric A contained approximately 80 per cent wool and fabric B approximately 20 per cent wool.

Union fabric. A cotton filling worsted warp fabric. This was selected because the cotton filling could be accurately separated from the worsted warp by hand, thus affording a means of checking the chemical separations.

Shoddies. A. A carded shoddy carbonized by the sulfuric acid process. B. A carded shoddy carbonized by the hyrdochloric acid gas process.

Worsted top. Several qualities of worsted top ranging from a 70s down to a carpet wool top.

Worsted Yarns. Several sizes and qualities.

In addition to the above listed materials, a number of commercial samples were used such as, 1. Dyed Merino shirtings, 2. Automobile and Upholstery fabrics, 3. Shoddy fabrics and blankets, 4. Felted fabrics such as overcoatings, 5. Commercial felts.

EXPERIMENTAL WORK

I

The Use of Sulfuric Acid

A. The Effect of Sulfuric Acid (from 70% to 85%) on Wool and Cotton.

Solutions of sulfuric acid were prepared varying from 70 to 85 per cent of H_2SO_4 by weight, at 1 per cent intervals.

Skeins of worsted yarn previously extracted with carbon tetrachloride and water washed, were oven dried at 105-110° C. and weighed; then braided with skeins of raw cotton yarn in the ratio of 60 per cent wool to 40 per cent cotton.

The above solutions of acid were brought to a temperature of 100° F. and the prepared samples were immersed in them for 15 minutes. The acid, of a volume in ml. equal to 100 times the weight of the sample in grams, was contained in an Erlenmeyer flask and agitated frequently during immersion of the sample. Each sample was then poured onto a 100 mesh screen and the excess acid flushed off with a large amount of water, then transferred to a gooch crucible (no asbestos) and washed thoroughly with water. It was then placed in a beaker and neutralized with a 2 per cent sodium bicarbonate solution, the samples being immersed for 5 minutes at room temperature. It was transferred again to the gooch crucible and washed thoroughly with water, oven dried and weighed.

The results given in tabulated form below, indicate that the increase in weight of the wool is not proportional to the increase in concentration of the sulfuric acid solution.

TABLE II

% H_2SO_4	*% Gain Wt. Wool*	*% H_2SO_4*	*% Gain Wt. Wool*
70	1.82	78	3.67
71	1.89	79	3.75
72	1.96	80	4.50
73	2.06	81	4.54
74	2.15	82	4.72
75	2.51	83	6.02
76	3.40	84	6.36
77	3.55	85	6.75

Difficulty was experienced in removing all of the cotton by means of the acid solution. Any method to be reliable must remove the cotton completely, leaving a clean wool residue.

Several of the above determinations were repeated, using boiled out cotton in place of raw cotton. This cotton was almost completely removed although considerable agitation was necessary.

The difference in solubility between raw and boiled out cotton in sulfuric acid indicated that some pretreatment of the sample might so affect the cotton so as to make it more easily soluble in the acid. Observations of the manner in which the acid appeared to attack the cotton showed

that the question of wetting out of the cotton was an important factor.

B. Wetting Out Agents.

The use of some of the newer types of wetting agents was investigated with very unsatisfactory results. The concentration of sulfuric acid was so great as to cause these agents to lose their wetting power and in most cases they were precipitated.

C. Various Pre-Treatments of the Sample.

Newer types of detergents such as the sulfated fatty alcohols were investigated. These detergents had no appreciable effect on either the wool or the cotton, the results obtained being much the same as when no cleaning treatment had been given.

An investigation of the starch hydrolyzing enzymes used according to the method recommended by the Bureau of Standards in their report on Fiber Separation[9], was made to ascertain if such a treatment would render cotton more susceptible to attack by sulfuric acid. It was found that a desizing treatment of this nature has no appreciable effect on the cotton as far as its solubility in sulfuric acid is concerned.

The use of ethyl alcohol as a wetting agent was suggested. The work on the effect of sulfuric acid on wool was repeated but this time the samples were wet in 95 per cent alcohol, squeezed to remove the excess, then immersed in the acid. The increase in weight of the wool was the same as when no alcohol was used, indicating that the alcohol had no effect on the determination as far as the wool was concerned. The effect of the alcohol was very noticeable however, when the acid came in contact with the wet out cotton. The cotton (raw) was completely dissolved in 5 to 6 minutes with moderate agitation, as against a minimum of 15 minutes for unwet cotton, with considerable agitation.

The work completed up to this point suggested a possible method for determining the amount of wool in a wool-cotton material, by the use of sulfuric acid.

D. The Use of 77½% Sulfuric Acid, with Alcohol Pretreatment.

A prepared, weighed sample was wet in 95 per cent alcohol, squeezed and immersed in 77.5 per cent sulfuric acid (by weight) at 100° F. for 15 minutes with frequent agitation. It was collected, washed, neutralized, washed, oven dried and weighed.

The selection of 77.5 per cent sulfuric acid by weight, was governed by three major considerations. 1. It represented a concentration which need be only approximately correct, and was obtained by averaging the results of concentrations 76 per cent to 79 per cent as given in Table II. These concentrations caused a gain in weight of the wool of 3.40 per cent to 3.75 per cent, with an average of 3.6 per cent at 77.5 per cent acid concentration. 2. This selected concentration removed the cotton more quickly than concentrations below this. 3. Correction factors must be kept as small as possible consistent with small damage to the wool.

The time, 15 minutes, allows for tightly twisted cotton yarns to be dissolved.

In calculating the results a factor of .964 must be used to correct for the gain in weight of the wool, which averages 3.6 per cent.

A temperature of 100° F. was selected, since sulfuric acid of these concentrations is much less viscous at 100° F. than at room temperature. This allows the acid to make better contact with the cotton, particularly when agitated and permits diffusion of the cellulose degradation products to take place at a greater rate, thus speeding up the solution of the cotton by the acid. Higher temperatures tend to cause greater damage to the wool both physically and chemically.

A large number of analyses were made on merino fabrics by the caustic boil method and by the acid method given previously. The results (average) were quite satisfactory.

TABLE III

Fabric	*Cotton by KOH Factor* 1.03	*Wool by* H_2SO_4 *Factor* .965
A	21.7	78.7
B	79.3	21.5
C	19.1	81.5

This method was tried by cooperating laboratories and the results were considered satisfactory.

One of the disadvantages of the caustic boil method is the necessity for using a correction factor for the loss in weight of the cotton in the analyses. The above outlined acid method also must have a correction factor which is a serious drawback to any method.

A method was desired which would give results directly without the need of a factor. It was decided that further investigation might produce a method wherein no factor would be necessary.

E. The Use of 70% Sulfuric Acid, with Alcohol Pretreatment.

Among the concentrations of sulfuric acid investigated seventy per cent acid shows the smallest gain in weight. Below this concentration damage to the wool begins to increase.

Trotman[10], in his work on the action of acids on wool, states that with increasing concentration of acid a point is reached (70 per cent) at which there is a deceleration in the rate of exhaustion of the acid from the liquid phase, and that in the case of 70 per cent sulfuric acid there is very little action on the wool, as measured by change in nitrogen content. Agitation is not so harmful to wool at 70 per cent acid concentration as in more dilute solutions.

Since 70 per cent sulfuric acid shows the smallest gain in weight of the wool as well as the least damage, phy-

sically and chemically, it was thought that some combination of temperature and time might be found where no increase in weight would be shown by the wool.

TABLE IV

Effect of 70% Sulfuric Acid at 110° F.				
Time in min.	10	15	20	30
% Gain weight of wool	2.33	1.43	1.06	.86
Effect of 70% Sulfuric Acid at 120° F.				
% Gain	1.65	0.45	0.43 Loss	1.32 Loss

The above results indicate that 70 per cent sulfuric acid for 15-20 minutes at 120° F. should give a wool residue with little or no gain or loss in weight.

A number of analyses were made on merino fabrics using 70 per cent sulfuric acid at 120° F. for 15-18 minutes, wetting out the sample with alcohol. The results were quite satisfactory. A worsted warp, cotton filling fabric which was analyzed by manual separation of warp from filling, as well as chemically by this acid method gave the following results:

TABLE V

	Analysis by Manual Separation	*Analysis by Sulfuric Acid*
% Cotton	50.7-51.6	50.9-51.5
% Wool	49.3-48.4	49.1-48.5

These results show a very good check on the actual cotton and wool content.

A determination of the sulfate sulfur was made on wool treated by the above method. The acid treated wool, neutralized and washed was dissolved in boiling 5 per cent caustic potash, cooled and acidified with hydrochloric acid. The solution was filtered, barium chloride added to the filtrate, heated, filtered, washed and ignited.

Total Sulfate 2.96-2.98%

This indicates that there is present in the sample sulfate sulfur, not removed by neutralizing, the net result being however, neither a gain nor a loss. Mease[8, 12] has also shown that such a condition exists.

This revised acid method was given a trial by five cooperating laboratories. The results reported were in general too high, the wool showing a gain of 0.5-2.5 per cent. An investigation revealed the fact that each laboratory had used a different grade or quality of wool. It was suggested that the effect of wool quality on the results obtained by this method be investigated.

Worsted yarns of low ¼ blood, ½ blood and 64s qualities were prepared by extracting with carbon tetrachloride and water washing. They were oven dried and weighed, then braided together with cotton yarn in the ratio of 80 per cent wool, 20 per cent cotton. These samples were given a treatment with 70 per cent sulfuric acid at 120° F. for 15 minutes, washed, neutralized, washed, oven dried and weighed.

TABLE VI

Results	¼ Blood	½ Blood	Fine 64s
%	Gain .21	Loss .02	Loss .09

These results indicate that wool quality has no appreciable effect on the results obtained by this method. A further check was made on the following qualities of top:

Carpet Wool, Low ¼ Blood, ¼ Blood, ⅜ Blood, ½ Blood, 64s, 70s.

The results varied, in some cases showing a 1 per cent gain and in others a .3 per cent loss. There was no definite trend or relationship between the results obtained and the quality of wool, further substantiating the above results.

Since quality of wool has no effect, the high results obtained by the cooperating laboratories were due to some other factor. A great number of analyses were made by this method on merino fabrics, with varying results. An examination of the wool residues showed that in many cases the cotton was not entirely removed. This would explain the conflicting results obtained by the cooperating laboratories.

F. Pretreatment with Dilute Sulfuric Acid.

A consideration of the work of Birtwell, Clibbens, & Geake[13] on the acid hydrolysis of cellulose suggested a pretreatment of the sample with boiling, dilute sulfuric acid. This would cause partial hydrolysis of the cotton cellulose and thus render it more susceptible to attack by the strong acid. It would also thoroughly wet out the sample.

Solutions of sulfuric acid containing 1 per cent, 2½ per cent, 5 per cent, 7½ per cent, and 10 per cent of H_2SO_4 by weight, were prepared. Skeins of raw cotton were immersed in the above solutions at a boil for varying periods of time, lifted, cooled, squeezed and immersed in 70 per cent sulfuric acid by weight, at 100° F. They were agitated frequently during immersion. Under these conditions the cotton was completely dissolved in 4-5 minutes and that with only moderate agitation. One per cent acid appeared to be just as effective as 10 per cent and 5 minutes as 10 or 15 minutes.

The combination of heat and dilute sulfuric acid initiates hydrolysis of the cellulose, which is completely in the concentrated acid with consequent solution.

In order to determine the effect on the wool of pretreatments with dilute sulfuric acid, skeins of worsted yarn were prepared as usual, and treated at a boil in the aforementioned dilute solutions of sulfuric acid for varying periods of time, with the following results:

TABLE VII

	1% H_2SO_4			
Time in mins.	2	5	7	10
% Loss weight of wool	.16	.54	.83	1.42
	2½% H_2SO_4			
% Loss weight of wool	.21	.63	.92	1.51

	5% H_2SO_4			
% Loss weight of wool	.44	.93	1.17	1.92
	7½% H_2SO_4			
% Loss weight of wool	.76	1.44	1.92	2.31
	10% H_2SO_4			
% Loss weight of wool	1.02	2.21	2.98	3.63

A number of determinations made previously show that wool when treated in 70 per cent sulfuric acid at 100° F. for 15 minutes gains 1.8-2.0 per cent in weight. The following method was evolved from the combined data:

Approximately a 2 gram prepared sample, oven dried and weighed, is immersed in 200 ml. of a 7½ per cent solution of H_2SO_4 by weight, at a boil for 6-8 minutes. It is collected on a gooch (no asbestos) and the excess acid removed by suction, then transferred to 200 ml. of 70 per cent H_2SO_4 (by weight) at 100° F. and worked 15 minutes. It is collected again on a 100 mesh screen or gooch crucible and washed, neutralized with a 2 per cent solution of sodium bicarbonate, washed, oven dried and weighed.

This method was sent out together with samples to ten cooperating laboratories for trial.

The results reported were in good agreement with the exception of those from one laboratory, which were so far at variance that improper use of the method seemed indicated. The check among the other nine laboratories was within 1 per cent, which is considered good for methods of fiber analysis. One of the samples was analyzed manually and the acid method checked the manual method within 0.5 per cent. These results covered only virgin wool.

Samples of shoddy or reworked wool were distributed among five cooperating laboratories for trial of the above method. The results were quite unsatisfactory, this type of material showing losses of from 2 to 5 per cent. Shoddy or reworked wool is usually damaged, this damage making the wool more susceptible to further damage or attack by the acid treatments upon which this method is based. It was felt that any method to be of value should cover reworked wool as well as virgin wool.

The above acid method was based on the supposition that the loss in weight of the wool in the dilute acid treatment was replaced by an increase in weight of the wool in the concentrated acid, the net result showing a gain or loss of 0.5 per cent or less.

It was agreed that the 7½ per cent acid was too strong and the time element too critical for routine laboratory analyses, and that further investigation should be made in an effort to find a set of conditions which would not be so critical and which would cover shoddy or reworked wool as well as virgin wool.

The supposition that the loss in dilute acid was replaced by a gain in the concentrated acid of approximately the same magnitude, was shown to be true in the case of virgin wool. Shoddy or reworked wool, being damaged, did not react the same to the two acid treatments as did virgin wool. It was assumed that the damage already present in the shoddy was further increased by the dilute acid treatment at a boil, this increase in damage making the shoddy more susceptible to attack by the concentrated acid. For example: if a sample of shoddy shows a loss of 3 per cent in the dilute acid treatment and a fresh sample shows a gain in weight of 3 per cent in the strong acid, the natural supposition would be that when combined, one would counterbalance the other and the net result would be a zero gain or loss. This is not the case since the dilute acid treatment changes the properties of the shoddy such that it may regain only 1 per cent in weight leaving a net loss of 2 per cent.

The trial and error method was used in an effort to arrive at a combination of treatments such that the net result would be approximately ± .5 per cent. This was found to be a preboil of 1 per cent sulfuric acid for 7-10 mins. followed by a treatment in 70 per cent sulfuric acid at 100° F. as given in the final method.

The application of this method to commercial felts, particularly those made by the acid milling process was investigated. The results obtained on different weights or thicknesses of felts were quite erratic. The problem of sampling is very important. Also acid milled felts are usually somewhat damaged, making their behavior in the acid treatments uncertain. We do not feel that this method is applicable to commercial felts.

The effect of peroxide bleaching on wool as regards this method of analysis, was investigated. Commercial samples of peroxide bleached and unbleached wool fabrics were treated according to the method of analysis given in this paper. The results obtained were considered to be satisfactory, that is the method works equally well for bleached or unbleached wool. Bleached wool gives results less than one per cent lower than unbleached wool. The results obtained with peroxide bleached wool are of the same order as those obtained with shoddy or reworked wool.

II

The Kjeldahl Method for Determining the Nitrogen Content of Wool as a Means for Estimating the Amount of Wool in Wool-Cotton Materials

Ruskowski and Schmidt[9] proposed the use of the Kjeldahl Nitrogen determination method for the estimation of wool in mixtures with cotton. This method for nitrogen determinations is a very accurate and reliable method. Its use as a means for determining the amount of wool in wool-cotton materials is open to question however.

J. Barritt[14] has shown that the nitrogen content of raw wools varies somewhat depending on the locality where grown and the quality of the fiber. The variation is small over a wide variety of wools with the exception of natur-

ally colored wools which are somewhat lower in nitrogen content than the white wools. He also found that a normal commercial scour tends to increase the nitrogen content slightly. The effect of sulfuric acid such as in carbonizing, is to diminish the nitrogen content and to a slightly greater degree than for a scour to increase. Therefore there are two opposing effects to consider in wool commercially carbonized.

An investigation was made into the use of the Kjeldahl method for nitrogen determinations as a means for estimating wool in cotton-wool materials.

Samples of worsted top were extracted for two hours with carbon tetrachloride and then given a warm distilled water wash. They were oven dried and weighed (.7-.8g.) and then placed in a Kjeldahl digestion flask. Twenty ml. of C.P. sulfuric acid were added plus 10 grams of powdered potassium sulfate and .2 gram of copper sulfate. A little broken glass and 4 grams of powdered pumice stone were added to prevent bumping. The samples were digested for one hour giving a clear melt. The melt was dissolved in distilled water, cooled and an excess of caustic soda solution was added carefully. The flask was then connected to a Kjeldahl distillation apparatus and distillation was carried on for one-half hour, the distillate being collected in 25 ml. of ½N sulfuric acid. The excess acid was titrated with 0.1N caustic soda using methyl red as an indicator.

A number of these determinations were made and an average value of 16.60 per cent nitrogen was obtained for the worsted top. It was found during these determinations that the time of digestion can be cut down from 4 or 5 hours, as recommended by many investigators, to 1 hour. The same results were obtained when digestion was carried on for 1 hour as for 5 hours.

Analysis of Merino Fabrics by Means of Nitrogen Determinations.

Nitrogen determinations were made on samples of the two special merino fabrics according to the above method. It was assumed that the wool in these fabrics had a nitrogen content of 16.60 per cent.

TABLE VIII

Percent wool calculated from N_2 obtained.

A	B
78.7	22.0

The value 22.0 per cent wool appears to be higher than that obtained by either the caustic boil or sulfuric acid methods on the same fabric, which is 21.1 per cent. Further determinations were made varying the size of the samples and the lowest value obtained was 21.7 per cent wool which was still high.

The Effect of Dyeing on the Nitrogen Content of Wool.

Some worsted top, extracted with carbon tetrachloride and water washed, was dyed with 5 per cent of Sulfon Cyanine Black B, Color Index No. 307, which contains approximately 10 per cent of nitrogen. Kjeldahl Nitrogen determinations made on this dyed wool gave a value of 16.43 per cent N_2 as against 16.60 per cent for undyed wool. Top dyed with 10 per cent of Direct Deep Black EW Color Index No. 581, containing 16.10 per cent nitrogen, gave a value of 16.44 per cent N_2. These results indicate that dyeing affects the nitrogen content of wool, a lower value being obtained for dyed than for undyed wool, even when the dye used contains approximately the same amount of nitrogen as the wool itself.

Although the difference in nitrogen content of different wools is small, when used as a basis for estimating the amount of wool in wool-cotton materials, this difference is multiplied six times. A Montevideo wool showing 17.07 per cent nitrogen and an Australian Merino 60s, 16.57 per cent have a difference of .5 per cent. This difference would increase to 3.0 per cent if used to estimate wool in a mixture. The only way in which this method could be used with reasonably accurate results, is when a sample of the original wool in a fabric is available, for which the nitrogen content can be determined and this used as a basis for the determination of the wool in the fabric.

CONCLUSIONS

1. An improved method for the determination of wool in wool-cotton textile materials by the use of sulfuric acid has been developed and reported.

2. The Kjeldahl method for determining the nitrogen content of wool as a means for estimating the amount of wool in wool-cotton textile materials was found to be less reliable for routine work than the sulfuric acid method herein described.

This paper is concerned with the analysis of wool-cotton materials, but preliminary observations as to the effect of the recommended procedure on the other fibers give the following indications:—

Silk: Completely dissolves.

Tussah Silks: The tussah fiber appears to dissolve com-

TABLE IX

Analyses of Merino Fabrics Dyed With 10% Direct Deep Black EW

Fabric	*Dyeing Method*	*% Wool by Kjeldahl Nitrogen*	*%Wool by Caustic Boil Factor 1.03*	*%Wool by Sulfuric Acid**
Merino A	Direct	77.0	78.8	78.4
Merino A	Direct, aftertreated with formaldehyde	78.0	78.5	78.6
Merino B	Direct	22.1	20.8	20.7
Merino B	Direct, aftertreated with formaldehyde	22.1	21.0	20.8

*Method 1, given on page P298, factor .965.

pletely, leaving a very small residue of woody, non-fibrous material.

Regenerated Cellulose Rayon: Completely dissolves.

Acetate Rayon: Completely dissolves.

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CALENDAR OF COMING EVENTS

Council Meeting, Boston, Massachusetts, June 12, 1936, 10 A. M.; Research Committee meets at 2 P. M.

* * *

Outing, Northern New England Section, Nashua Country Club, Nashua, N. H., June 12, 1936.

* * *

Outing, Rhode Island Section, June 19, 1936.

* * *

Annual Outing, Philadelphia Section, June 19, 1936.

* * *

Outing, Mid-West Section, Oshkosh, Wis., June 20, 1936.

* * *

Outing, New York Section, North Jersey Country Club, Paterson, N. J., June 26, 1936.

* * *

Summer Meeting and Outing, Piedmont Section, June 27, 1936, Ocean Forest Hotel, Myrtle Beach, S. C.; reservations through Mason Alexander, manager.

* * *

Annual Meeting, Providence, R. I., December 4 and 5, 1936.

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A Birthday

JUST about a year ago the N R A was invalidated by a unanimous decision of the Supreme Court which decision resulted in many predictions as to the probable consequences of such a decision. Many were pessimistic in their attitude; depression would begin again; payrolls would be cut; employment reduced; labor disputes would increase; in fact it was stated the whole recovery movement would be ruined. After a year what do we find? We find that the recovery movement is at its highest level since 1929; factory employment and payrolls have advanced; retail sales and bank deposits have increased; there has been less loss of work due to labor troubles; building construction is way ahead of last year; production of practically every staple has increased. Whether this advance from the last days of the N R A regulation is due to its abolishment, whether the N R A set in motion the wheels of progress which carried through this past year or whether there would have been greater improvement during the past year if the N R A were still functioning are all points of argument. You will find someone to defend one of these theories but to whatever we may attribute recovery, it is at least apparent that the past year has been one of progress and an increased confidence in the future.

Graduates

JUNE is the month of weddings and graduations. We have no figures available on the probable number of weddings but it has been conservatively estimated that there will be 50,000 or more students graduating from technical institutions. It is with this latter group that we are concerned, as most of its members will in all probability soon be looking for employment unless they have been fortunate enough to have already located a position. Many of them will look for such employment in the textile and allied fields; this of course is especially true in the case of graduates from textile schools.

If positions would be created a great many could find employment in textile mills, dyestuff and textile chemical laboratories, testing laboratories and the like. Naturally any business house would hesitate before creating a vacancy for an untrained man but it is just that fact that would make the recent graduate of value; he could be trained in the manners and policies of his employer so that his efforts would be spent in the proper channels. It is true that training a new employe costs money; this expenditure however should be viewed in the light of an investment. Such an investment will not *always* pay a satisfactory return but we believe that it is about as safe an investment as there is available. The education itself can also be considered an investment. The student spends several years and considerable money simply to prepare himself to do whatever work he will have to do better than he would be able to do it otherwise. He certainly will do his utmost to realize for himself a fair return on his investment; his return will be also a return for his employer. Whether there is an existing vacancy or whether it will be necessary to create one, business executives would do well to consider investing in technically educated man power.

CLAXTON MONRO

CLAXTON Monro, chief chemist of the American Woolen Company, died recently at his home in Andover, Massachusetts, at the age of 51. Mr. Monro had been associated with the American Woolen Company in various mills for the past 27 years and became chief chemist in 1930 at which time he was transferred to the administration building in Shawsheen Village. He was a charter member of the American Association of Textile Chemists and has always been active in the work of this organization. At the time of his death he was a member of the Research Committee of the A.A.T.C.C. as well as being active in the sub-committees on research program, fastness tests for dyed wool, methods of determining extraneous matter in textile materials, determination of fibers in mixtures and carbonization of wool. He was also prominent in church and civic affairs in the town of Andover.

He is survived by his widow, three sons and his father.

WILLIAM H. BERTOLET, SR.

WILLIAM H. BERTOLET, SR., founder and president of the Laurel Soap Manufacturing Company, Inc., died suddenly from heart disease at his home, 1410 E. Columbia Avenue, Philadelphia, on Saturday, May 9. He was seventy-four years old.

A native of Philadelphia, Mr. Bertolet has been in the textile industry for many years, beginning in the dyeing branch and later turning to the manufacturer of textile soaps and oils. Two years ago he celebrated the twenty-fifth anniversary of the founding of his business, of which he was president and treasurer. Mr. Bertolet was a member of Richard Vaux Lodge No. 384, F. and A. M.

Surviving are his wife, Mrs. Emily Richards Bertolet; four sons, Clarence E., Elmer C., George D., and William H., Jr., all associated with him in business; and two daughters, Mrs. Charles W. Hallworth and Mrs. John Lehn.

Services were at 2:00 P. M., Wednesday, May 13, at William Rowen Funeral Parlors, in that city. Burial was in the family plot in West Laurel Hill Cemetery.

Weighting of Silk

(Continued from page 294)

show that the decomposition of weighted silk is largely influenced by its pH and that maximum stability is obtained when the silk is left with a pH = 10.0.

In order to obtain a high degree of weighting it is necessary in practice to repeat several times the treatments of the silk with stannic chloride and sodium phosphate; with each repetition a further amount of tin phosphate is fixed within the silk, but, at the same time, the durability of the silk decreases. It has, therefore, been suggested that if the first weighting be carried out with tin phosphate in the usual manner then the presence of this substance in the silk might allow further weighting to be carried out with salts other than those of tin and, in this manner, the harmful influence of the tin phosphate avoided. According to U. S. P. 1,990,449, this suggestion can actually be achieved provided suitable zinc salts be used. Further, in certain instances the zinc salts can be replaced by those of cadmium, but generally, mainly on account of its lower cost, zinc will be preferred to cadmium.

It is found that if silk, weighted once or twice with tin phosphate, is immersed in a solution of zinc sulfate only a small amount of zinc is fixed within the silk so that the increase of weighting is comparatively small. In considering this process it would seem impossible to secure much weighting since any zinc fixed in the silk will result in a corresponding amount of sulfuric acid being liberated in the bath and, in turn, this would re-dissolve the zinc from the silk. Sulfuric acid is a strong mineral acid and its action is much more powerful than that of a weak organic acid, as for example, acetic acid. If, therefore, zinc acetate were employed instead of zinc sulfate there is the possibility that much more zinc would be fixed within the silk and thus a higher degree of weighting obtained. Actually this is so, and the argument holds good for other salts of zinc with a weak acid, or for solutions of zinc salts which are buffered by the addition of suitable substances so that any withdrawal of zinc results in only a small change in the pH of the solution. Thus a solution of zinc sulfate is satisfactory for weighting the silk if there is added sufficient of sodium acetate which acts as a buffer.

DEGREE OF WEIGHTING

The following description of the weighting process using zinc acetate illustrates clearly the degree of weighting possible:—

Firstly, 75 lb. of degummed silk is steeped for one hour at room temperature (15° C.) in stannic chloride of 32° Tw., then rinsed with cold water, and steeped for one hour at 75° C. in a solution of disodium phosphate of 8° Tw. By this treatment the weight of the silk is increased to 86 lb., but by repeating the process the new weight becomes 102 lb. So far, ordinary weighting methods have been employed and it is now that the new treatment is carried out. For this, the tin-weighted silk is steeped for one hour at 60° C. in a 4° Tw. solution of zinc acetate and then washed; the silk thus increases in weight to 108 lb. But when further treated for one hour at 60° C. with a solution of disodium phosphate of 9° Tw. the weight jumps up to 120 lb.

A repetition of the treatments with zinc acetate and disodium phosphate results in a weight of 139 lb., and by a further repetition a weight of 169 lb. can be reached and this is just twice that of the original silk. In spite of this high degree of weighting, the silk remains soft and of a good color, and it is claimed that even further weighting can be obtained by simply repeating the zinc acetate and disodium phosphate treatments.

There is a variation of the weighting process as described above, in which the silk is first weighted not only with stannic chloride and sodium phosphate but also with sodium silicate. It appears that, in some ways, this variation has advantages, especially when an ammoniacal solution of a zinc salt is used. The following example shows this.

ADVANTAGES IN VARIATION

Firstly, 75 lb. of degummed silk is treated twice with stannic chloride and disodium phosphate so that it attains a weight of 102 lb. as previously described. It is then treated for one-half hour at 60° C. in a 4° Tw. solution of sodium silicate to bring its weight up to 116 lb. The silk is then steeped for one hour at 60° C. in a 4° Tw. ammoniacal solution of zinc acetate (prepared as described later) and again treated with sodium silicate as before; the silk attains a weight of 170 lb. Another treatment with the ammoniacal zinc solution and sodium silicate brings the weight up to 195 lb. and it is yet possible to increase the weight without damage to the silk by repeating the treatments. It is evident that by using an alkaline zinc acetate solution increased weight in the silk can be attained more rapidly than when neutral zinc salt solutions are employed.

The ammoniacal zinc solution used as described above is prepared by adding ammonia of 0.920 sp. gr. to a concentrated solution of zinc acetate until the white precipitate which at first forms completely dissolves. The product is then diluted to 4° Tw. by addition of water but it will be necessary in this process to add a further small amount of ammonia since zinc oxide tends to precipitate in the dilute liquor.

It is important to notice that although most of the weighting is obtained with zinc salts, the volume of the silk fibers increases in much the same manner as with tin phosphate alone.

Turning now to U. S. P. 1,990,450, it will be seen that lead salts can be advantageously introduced into the weighting process so that the silk becomes even more soft and fluffy while preserving a good white color. Actually, this process really makes use of a discovery noted in an earlier patent (U. S. P. 1,579,628). Tin-weighted silk has the property of absorbing lead salts, such as lead acetate, and this not only results in increased weighting but, at the same time, the lead increases the elasticity of the silk fiber and improves its durability and dyeing properties. It is thus fortunate that weighting with zinc and lead salts can be combined as the following example shows:—

75 lb. of degummed silk is first weighted to 102 lb. by two treatments with stannic chloride and disodium phosphate as previously described. It is then steeped for one hour at 60° C. in a 4° Tw. solution of lead acetate, washed, steeped for one hour at 60° C. in a disodium phosphate solution of 9° Tw., rinsed, and further steeped for one-half hour at 60° C. in a 4° Tw. solution of sodium silicate so that the weight of the silk is then raised to 142 lb. The silk is now ready for steeping one-half hour at 60° C. in a 6° Tw. solution of zinc acetate and, at this stage, although the silk has not gained in weight, it has acquired the property of increasing to a weight of 183 lb. when treated with sodium silicate solution. By again treating successively with the zinc acetate and sodium silicate solutions it is possible to bring the weight up to 233 lb.

The main feature of the above processes is that the bulk of the weighting is obtained with insoluble metal salts other than those of tin and, on this account, it is claimed that the silk is more durable and superior in several other respects. Further, it would appear that the weighting obtained with these zinc and lead salts requires fewer treatments than is the case with ordinary tin-weighting.

Do Clothes-Moths Attack Rayon?*

By A. HERFS†

IN the last issue of "Kunststoffe" for 1933 there was a short article by Max Speter, in which were made public certain observations of damage to rayon articles by clothes-moths. Speter considered that he had proved that clothes-moths, in spite of statements to the contrary, do attack not only wool, but rayon. This article by Speter was then taken up in "Umschau" a few months later, and has also been cited and generally disseminated by the public press. Since, in Speter's work, the case dealt with was a casual one, which was not studied by a professional entomologist or zoologist, it might well be stated, since the public in general has been given a certain impression in the matter, that from the expert entomological side exception is taken to the accuracy of the assertion.

It may be mentioned that the present author has been working for the past twelve years upon the question of wool being attacked by zoological agencies, and from the strictly scientific viewpoint; and has, through exhaustive study, become informed from his own observations regarding the physiology of nutrition of the clothes-moth. His principal attention has for years been directed to the question whether insects attack rayon, and through his personal experience he has determined whether, and how far, the clothes-moth does feed upon viscose rayon, and so how it may come into question as to whether it is a harmful influence as to the newest development of the textile industry.

For the question as to what materials are consumed by an animal organism in the general sense, it is important to distinguish between the two concepts of "food-material" and "edible matter". Under the first term can be comprised only those substances which are chemically decomposed in the digestive tract, and are suited to making possible the development, the continuation, of the normal life-process, of an animal. In the present case, therefore, we are dealing with what is involved in the concept of "food-material". From this class of foods, however, must be excepted such substances as are taken up by an animal under some circumstances, as, for example, in hunger, or merely incidentally, which pass into the digestive tract, and are expelled in an undigested condition together with the normal excrement. Such substances are not suitable for actual food, and do not make possible a normal continuation of the life-process. They are not digested; that is, not chemically. In most cases, these edible substances, casually taken in through indiscriminate hunger or for other causes, are absolutely without value for the needs of the normal body. In certain cases they may play a not unimportant part in the digestive process. This is the case with birds, who eat all sorts of indigestible substances,

*Translated from Melliand's Textil-Berichte 16, 56 (1935).

†Zoological Laboratory of the I. G. Farben-Industrie, Leverkusen, Germany.

principally sand and small pebbles, which serve, in the digestive tract, as comminuting agents toward the food proper, so as to afford valuable mechanical assistance to the chemical process of digestion. To the class of edible, but for nourishment quite worthless, substances belong hair and larger bones, which predatory birds must take in with the body of their prey; which, however, cannot be decomposed by the digestive fluids, and cannot come into question as of food value. Predatory birds and the like secrete no digestive ferment which is able chemically to attack keratine, the horny part of the substance of hair or fur. This all explains why predatory birds cast up hair and the larger bones of their prey, as vomit, as, in this case, a normal extra method of defacation. Hair and fur are also found in the excrement of some predatory animals (in the normal excrement). From this fact, that in the stomach and intestines, or in the excrement, hair or fur may be found, it should by no means be concluded that hair or keratine serve the host-animal as food. The difference between food and edible material is, furthermore, recognized in the human pace. Man takes in with actual nutrient food much indigestible substance, which must be expelled with the faeces (in fact, faecal matter is only just that materials which the digestive tract has been unable to assimilate). One needs, in this connection to be reminded only of the cellulose constituent of our vegetable foods, which for the most part leaves the digestive tract still undigested and practically unaltered. (There is, however, a high value to such indigestible matter as "roughage", but this is merely a mechanical assistant to the regular peristaltic movement of the material along the course of the intestinal tract). In those cases where cellulose can be considered as actual food in a certain race of animals, such animals have as a necessary agent in their digestive system either special digestive ferments, the zytases, which are able to decompose cellulose, or a means of decomposing cellulose in a more roundabout way, through micro-organisms which live in the intestines (protozoa and bacteria), which decompose the cellulose into such products as are capable of being digested by the normal digestive fluids, and so made available for the needs of the system. Thus, in the anterior stomach, especially in the paunch, of ruminants (cows), there is found a very large number of the most varied species of bacteria, which break up the cellulose of the fodder so that it can be normally digested. This same function is that also of certain bacteria living in the intestines, which especially carry on, in the colon and vermiform appendix (as we call it in our own bodies—greatly enlarged and functionally active in many lower animals), the function of cellulose digestion, so important for ruminants. Thus, ruminants such as the cow, and the horse also, are able to digest up to 30-70% of the cellulose contained in their fodder. Carnivorous animals, such as the dog, do not assimilate any cellulose. Characteristically, also, however, geese and hens, which so largely consume vegetable matter, are not able to digest cellulose.

Then, too, in the case of most insects which feed upon cellulose in different forms, it is the utilization of the work of symbiotic organisms which enables them to accomplish the digestion of cellulose. Thus, certain species of termites, from the families of the Mastotermitidae, Kalotermitidae, and Rhinotermitidae, shelter in their intestines flagellate protozoa, which decompose the cellulose of the wood upon which they feed. It has been possible to determine, through actual experiment, that the termites of themselves cannot digest cellulose. If one kills the protozoa inhabiting the intestine of these ants, the ants, still feeding upon wood, die of starvation after a time, though still feeding as usual. But if, before starvation has proceeded too far, one re-inoculates the intestine with the proper protozoa, they begin to live again normally. Most recently the view has been expressed, that these termites do not utilize nourishment from the wood which they consume, but live upon the protozoa themselves, which are living upon the wood ingested by the host, the termites thus living upon a continuously cultivated food within themselves. If this view were correct, the termites would live, not upon cellulose, but upon animal food. And, further, another process, that of decomposition of cellulose, within the digestive tract, by bacteria, is known to take place. In 1929, Backwith and Rose studied eight species of termites from six genera, as to their utilizing cellulose (filter-paper) as food. In these termites the intestinal protozoa were entirely absent, but bacilli and cocci negative to Gram's stain were found in the tract. Thus, as the experiments showed, the cellulose intake was decomposed by bacteria. In some cases termites live upon rotting wood, in this case fungi and bacteria performing for the termites the valuable anterior labor of breaking down the cellulose of the wood. Termites, which are typical consumers of cellulose, thus employ the most varied foreign organisms in order to be able to utilize the difficultly digestible cellulose. We have cited only a few characteristic cases of the sort, in order to illustrate clearly the manifold nature of the solution of the problem of the digestion of cellulose among insects—without having entered into the difficult and still more or less obscure region of the nutritional physiology of the termites.

As to ferments which decompose cellulose, only very few animals possess such means. Among vertebrates, such ferments appear to be entirely lacking. Only in the case of a very few invertebrates has it been possible to prove definitely the existence of a ferment which digests cellulose—in the case of lichenases, a cytase—e.g., among snails, and fresh water crustacea. A lichenase has been detected in the ship-borer, Teredo, in the earwig, Forficula, and in the moth Gastropacha rubri. Freshly dialyzed snail-enzyme ferments cupro-silk, viscose, or sulfocyanide-cellulose to glucose practically completely.

We have, then, before us a case in which an animal ferment can digest cellulose completely.

Animals which have not such a ferment available, or

which possess no symbiotes (protozoa or bacteria as colonists), which digest cellulose, can therefore certainly use no cellulose as food. Now, rayon consists of cellulose. In the production of rayon, hemi-cellulose is removed, and the difficultly soluble alpha-cellulose alone remains in the fiber.

At best, only such animals which ingest rayon can be considered, as are capable of digesting it. For all other animals, rayon remains as an absolutely useless source of food, which can never serve as nutriment, but at most —and then only under special circumstances—will be taken into the intestinal tract as a material wholly worthless to the organism. Among the clothes-moths, no means are known at all, which make possible the digestion of cellulose. They possess neither a ferment which digests cellulose, nor any symbiotes which can bring about its decomposition. For the clothes-moth, all materials consisting only of cellulose, as cotton, vegetable fibers, paper, straw, do not come into question. Yet it should not be denied that moths, particularly in a state of hunger, may consume small amounts of such materials, which, however, are later expelled in the excrement in an undigested state. E. Titschak observed, as long ago as 1922, that clothes-moths consume, in the state of hunger, every conceivable material, except straw, paper, asbestos, glass wool, spongin, and moth-excrement, all of which they refuse to eat. "In spite of the ingestion of these unnatural foods, the moths behaved as they would have done had all nourishment of any kind been withheld; they pupated rapidly, and produced more or less small imagines." This observation by E. Titschak was confirmed by the author in his own experiments, and were extended by him to the case of rayon. When allowed to feed at will upon rayon only, the moths behaved in nearly all cases as though starving. The larvae hatched from the eggs soon died. Older moths would here and there ingest a few fibers of rayon, but expelled them unaltered in their excrement, as could be easily observed with dyed rayon; and proceeded rapidly to abnormal pupation. Any further development could not be observed, when rayon had served as food. It is therefore not an important fact, from these observations, that one can detect rayon in the intestinal tract of the moth, or that moths do consume rayon can be proved by detection of a few bits of rayon in the excrement. Of much greater importance is the establishment of the facts in the question whether, and how far, the material eaten comes into question as nutriment. If one does not distinguish between what is edible and what is nutritious, a point to which Titschak drew definite attention in 1922, then false conclusions may easily be drawn from casual observations. It is important that, in all such experiments, the animals be kept carefully isolated during study. In mass-experiments, a normal development upon unsuitable nutriment (it is difficult to avoid a certain looseness of use of terminology) may be deduced from the unrelated actual fact that the larvae which consume unsuitable material because of hunger and undernourishment are able to develop normally to a certain point, regardless of conditions.

The fact that, in conditions of abnormal hunger, clothes-moth larvae occasionally consume—"feed upon"—rayon, cannot be denied. But the intake of rayon in the hunger-condition is so small in any case, that one can determine the amount of damage oftentimes only through the most careful examination with the microscope or hand-lens, even though, occasionally, separate tiny actual holes have been eaten out of the material. The extent of damage in experimental studies, even under the most rigid conditions, is so insignificant that, practically, it plays no part in the problem. The larva, in the hunger-condition, wanders away gladly from the unsuitable material, and creeps about until it finds some wool or other suitable food-material. If, in the experiment, the possibility of wandering away in this search is prevented, then, in the starvation-condition, occasional damage is caused through the larva eating even unsuitable material in its desperation. But if, in the experiment, the larva is given wool in the neighborhood of rayon, the rayon is practically always absolutely untouched. It is true that, now and then, when woollen material is lying very closely beside rayon, the rayon is occasionally damaged by the larvae. The larva gnaws and swallows the rayon fiber, in order to get at the wool fiber clinging to it. The rayon thus ingested casually is merely worthless "ballast", as far as the larva is concerned. Since, however, rayon possesses no deterrent properties (causing fright or nausea, etc., the two principals influencing the larva under ordinary life-conditions) it will in such cases be eaten with the wool without distaste. The case with mixed weaves is similar. If the rayon is woven or spun with the wool in a very intimate way, then the larva must injure the rayon fibers in order to get at the wool. The need of gnawing through the rayon offers no difficulty to the oral apparatus of the larva. But, if the rayon fibers worked up with the wool do not hinder the larva in getting at the wool, as in other types of yarn or weaves, then the rayon is practically always unattacked and undamaged.

Outside of these more casually occurring observations upon rayon, more extensive cases of damage were occasionally met with in the author's study. Such cases were always such as those in which the larvae found available only viscose rayon material, and no wool. In all such cases, in which extensive damage was brought about, it was proved that the rayon had been finished with starch, fatty, or tallowy substances. It is interesting that such finishing-agents are able to serve as actual food for the moth-larvae to a certain extent. Since they cling intimately to the fiber, the larva must consume the fiber in order to ingest the impregnating material. In this case also the fiber consumed is merely taken in, not really eaten, and is not utilized by the larva. It is excreted unchanged. Upon such finished rayon goods, the larva very soon behaves as though mal-nourished. The destruction of the rayon fiber, then, in such a case, is caused by the

presence of special, unusual conditions. It is not the fiber which is sought by the larva, but the impregnating material. Such a case, complete and extensive as the damage may be, must not be taken as meaning that the clothes-moth is to be considered as a special menace to rayon, or that a great industrial importance is to be ascribed to the moth as a source of danger to rayon goods; for the finishing-agent is taken in by the larva only in the absence of available keratin (wool-substance). In practical fields, the clothes-moth in any stage plays no role in reference to starch or substances containing it, although in a household infested with clothes-moths the insects would have abundant opportunities to penetrate into the pantry. Naturally, one should not confuse other small moths with the clothes-moth; for meal-moths and grain-moths (weevils) gladly settle down to breed among cereals, and occasionally find their way as pests into the household in that connection. If, on the basis of what has been cited above, anyone should maintain the clothes-moth to be a pest potentially threatening rayon, then the meal-moth, Ephestia Kuehniella, would have to be ranked among the organisms dangerous to silk. The author has seen bolting-sieves, from flour-mills, which had been completely ruined through the attack of the larvae of these insects. This is a case of used sieves, in which the silk gauze was strongly incrusted with meal. The meal-moths, which were essentially interested in the incrusted meal, had consumed the silk weave completely, as an incidental item. The clothes-moth also does not feed upon silk. If, however, in mixed weaves containing wool, the silk is intimately worked up with the wool, so that the larva, in order to get at the wool, must gnaw at the silk fiber, then the whole weave, silk and wool, is damaged without distinction.

The most serious damage to rayon in general, is found in bed-spreads, "puffs". In all these articles, the filling of the quilt is strongly attacked by moths (the filling is almost always some sort of wool). As a consequence, the damage, which originates in the filling, is extended to the covering itself. The case is to be explained as above, by the fact that the larvae naturally seek the wool-fiber, to which the rayon fibers of the covering are closely adherent or closely tied or knotted down, and so incidentally attack the rayon. The moth prefers to work upon a bounding surface. It feeds less upon the material in the interior of the wool-filling than upon the upper part of the layer, over which the rayon lies, where the larvae will naturally construct their tunnels. Here the mature larva prefers to undergo its transformation to the pupa, and spins its cocoon, usually, directly upon the rayon layer, through which, as a result, of course, severe damage can be brought about. Further, the developed and freed pupa bores its way out of the rayon layer, in order to make a free course for the moth to the outer air. It is in this way that the damage to the rayon layer originates. It is, however, not right to assume that the moths bore from without, through the rayon layer, into the underlying wool. The moth has a way of scenting out wool from a distance. The woolen material is rather usually infected by the moth before it goes into the article. The author was able to prove by observation that cushions and puffs, whose filling was of wool and whose covering was of rayon, showed damage only when the wool was infested by moths before the making-up of the articles. When the wool was absolutely free of moth-infection before working then both covering and filling were protected from moth-attack, even when the articles were kept in a room strongly infested by moths, and even when, in an experiment, several hundred moth-eggs were placed and left upon the covering.

This sort of damage to rayon coverings of quilts and coverlets is, industrially, the only significant case of damage to rayon being caused by moths. The cause of these troubles, which has been elaborated above, is, according to the author's studies, not to be explained by the moths consuming rayon as food; the real cause is, according to the author's view, of entirely a secondary nature. If one wishes to "protect" bed-quilts, etc., then, at the time of working the article up, one must have absolute assurance that the wool is completely free from moths in any stage of their development. This condition is to be fulfilled only with the greatest difficulty; for even with the greatest care and cleanliness preceding, the most careful and painstaking disinfection cannot assure us that, in the working up of the material, moths have not gotten into the wool and laid their eggs there. If they have done so, then, sooner or later, their presence will be shown in the covering of the article by the characteristic marks of moth-damage. The most certain safeguard against this vexatious occurrence can be attained, if one uses as filler such a material as is not attacked by moths normally; for example, cotton batting. If one does not wish to forego the advantages possessed by a wool filling, it is recommended that one use a filling impregnated with Eulan. No one will then have to complain of moth-eaten coverlets. The author has proved this self-evident fact by experiment, by infecting with moth-eggs a wool filling for cushions, treated with Eulan before working up. The eggs hatched out in a few days. As the larvae found no available nourishment, they soon died. The rayon covering remained intact, and was not attacked in any respect by the larvae. This result proved plainly that the clothes-moth is not a true pest as to rayon, otherwise the covering would then have been attacked, in default of the wool, which has been made immune to attack by the Eulan.

All of these facts show clearly, how careful we should be, in drawing conclusions from incidental observations, without a thorough knowledge of the biological and physiological characteristics of an insect. As a rule, damage from the feeding of an insect upon a material acquires a great industrial significance only if the material damaged is usable as food, actual food, by the insect. Substances accidentally ingested by the insect, in the state of hunger, may certainly lead to minor damages, but those cases are without importance from the industrial standpoint. Only special circumstances, such as we have pictured, can al-

low occasionally serious damage, which may be serious enough in itself, to take place in a material wholly unsuited for a food.

An exception to this rule may perhaps be afforded by a few social insects, and those only, such as the termites, and the ants which cultivate fungi as their food. For the building of their nests and tunnels, and for the planting of their gardens, these social insects cause often severe damage to the most varied material, without the substances damaged, and partly ingested, serving directly as food. Such a situation is a special case, which is conditioned by the social life-customs of these insects; and should not be given a general significance without further real investigation. The clothes-moth, as a kind of prejudiced, one-sided specialist in nutrition, will use only the keratinous wool-fiber as food, out of all the textile fibers available, while silk, cotton, and rayon are valueless for its purpose, and as a rule are not attacked. The explanation of the reason why the moth consumes only keratinous animal fiber, but not vegetable or regenerated fibers, is to be sought in the fact that, in the economy of nature, it nourished itself in primeval times from animal remains, and, e.g., consumed the dry animal (prey) cadaver down to the very skeleton. As ages passed, the moth, in parallel with the cultural development of mankind, adapted itself to woolen fibers, and to materials found in association with wool—animal fibers and bed-feathers. This adaptation to a special diet was made possible by the fact that the moth has available within its digestive tract a ferment which dissolves and digests keratin. Since, however, means for the digestion of cellulose are entirely lacking, an adaptation to the use of a vegetable fiber as food, such as cotton, and so any of the forms of regenerated cellulose, has proved impossible.

New Products—Trade Notes

• SURVEY OF WORLD CHEMICAL INDUSTRY

Efforts to create satisfactory synthetic products to take the place of natural imported raw materials and research into new chemical uses for surplus farm crops was intensified in 1935 and the early part of the current year, according to a world survey of the chemical industry made available today by the Commerce Department's Chemical Division.

Every leading industrial country of the world as well as many of the smaller nations have been striving to attain a higher degree of self-sufficiency insofar as their chemical and related product requirements are concerned and some of the countries are now developing export markets for products which until recently they imported, the survey shows.

Many restrictions hampering the flow of international chemical trade continued in 1935, as in previous years, though a number of countries reduced duties and increased quotas on raw material and other imports.

In some countries the exportation of anything but processed materials of certain products was stopped in order to retain monopolies, as in Brazil where the exportation of carnauba and oiticica seeds was prohibited to prevent planting outside the country. Likewise Peru, for the same reason, now prohibits the exportation of green cube roots, and Brazil is contemplating the same action, according to the survey.

Governmental and private agreements, particularly barter arrangements, continued to exert considerable influence upon international trade in chemical products, and cartels became increasingly effective through the widening of memberships, it was stated.

In spite of all handicaps, however, it appears the volume of international trade in chemicals and allied products increased somewhat last year, though keener competition lowered prices and curtailed profits considerably.

Japanese and Russian competition was lessened in certain lines, the survey shows, but Germany was more active than during the preceding year. German exporters, assisted and otherwise encouraged by the Government, frequently sold chemical products in foreign markets at less than current prices in order to release frozen credits.

A large number of barter arrangements with various countries in which Germany generally supplied finished goods in exchange for needed raw materials were consummated, according to the survey.

Although production data are lacking, it is believed the United States continued to hold its position as the world's leading producer and consumer of chemicals. Germany remained the largest exporter of such products; foreign shipments from that country showing a 2 per cent increase in value over the preceding year against a 9 per cent increase in United States chemical exports.

The world chemical survey, which was conducted by C. C. Concannon, Chief of the Commerce Department's Chemical Division, covers developments in close to 50 foreign countries, 40 of which are presented in considerable detail. Latin America, a region that is steadily growing in importance as an export field for American chemical products, is stresesd in the survey, and considerable space is given in the 200 page booklet to new commodities and new uses, and barter, cartel, and other marketing arrangements.

The survey, "World Chemical Developments in 1935", known as Trade Information Bulletin No. 832, can be obtained from the Superintendent of Documents, Government Printing Office, or from any of the Department's District Offices located in the principal commercial centers of the country, at 15 cents per copy.

• PRINTING COLORISTS GUILD

A meeting of the Textile Printing Colorists Guild, Inc. was held on Saturday afternoon, May 16th, at the Elks Club in Paterson, N. J. Following the business meeting, about 100 members and guests attended a luncheon. Dr. I. F. Chambers presented a paper entitled "Some Technical Aspects of Vat Color Printing", which was followed by a discussion.

• GENERAL RELEASES

General Dyestuff Corp. announces release of circulars on the following products:

Celliton Fast Navy Blue B F—which is superior to the older General brand "B" in fastness to light and chlorine and shows also a brighter shade. Circular L.G. 1186.

Celliton Fast Brown B T—which produces a very attractive brown shade said to be of excellent fastness to light and to possess excellent level dyeing properties on acetate. Circular I.G. 1187.

• ADDITIONAL QUARTERS

It is announced that Pfaltz & Bauer, Inc., importing agents, have found it necessary to acquire additional quarters on the thirtieth floor of the Empire State Building in New York City, in order to provide adequate facilities for many new activities. A permanent display of scientific interest has been set up in the new quarters. The downtown warehouses at 300 Pearl St. and 12 Peck Slip will be retained.

• ANNUAL MEETING, A.I.C.

The annual meeting of The American Institute of Chemists was held in Buffalo, New York, on May ninth.

Among the speakers at the morning sessions were Frank G. Breyer, "Forty-five and No Job;" Max Trumper, "The Chemical Frontiers;" Maurice C. Taylor, "The Industrial Research Chemists' Balance Sheet."

At the afternoon meeting, William J. Cotton spoke on "Opportunities for Service by the Institute."

Marston Taylor Bogert was presented the Institute's medal for "noteworthy and outstanding service to chemistry or the profession of chemists in America," at the banquet in the evening. The subject of his address was "The Onward March of Synthetic Organic Chemistry." Among others who spoke at this banquet were: R. R. Renshaw on "The Medalist," and M. L. Crossley, on "Privileges and Obligations of the Chemical Profession."

• CONFERENCE ON TEXTILE DRYING

That many textile fabrics and products could be materially improved in strength, finish and wearability, if middlemen and consumers were willing to pay a slight premium for the extra time and cost of better drying during their manufacture, was one of the important facts brought out in the discussion at the conference on textile drying problems held at the Hotel Pennsylvania in New York on May 6th by U. S. Institute for Textile Research. Some 150 manufacturers from all branches of the industry were in attendance, and the discussion demonstrated that drying, although vastly improved in recent years, is far from being standardized on a scientific basis.

Chairman W. E. Emley of U. S. Institute's Research Council, and chief, Organic and Fibrous Materials Div., National Bureau of Standards, was the presiding officer, and his scientific knowledge of fiber properties and the thermodynamics of drying, as evidenced in his introductory remarks and throughout the discussion, was an important contribution. Those who led the discussion for different classes of materials and presented brief papers at the morning session were as follows: Cotton, P. B. Wendler, Joseph Bancroft & Sons Co.; Wool, E. N. Angus, Eavenson & Levering Co.; Rayon, Dr. F. Bonnet, The Viscose Co.; Silk, E. N. Ditton, Gotham Silk Hosiery Co. A number of representatives of drying machinery manufacturers also presented papers.

Following luncheon the conference reconvened at 1:30 P. M. for open discussion, which lasted until late in the afternoon. Secretary C. H. Clark of U. S. Institute presented a reference list of published articles and books on textile drying, and drew attention to the fact that the literature is practically devoid of accurate scientific information as to the temperatures and related conditions under which the different textile fibers, and products made therefrom, can be dried with certainty that their natural properties will not be injured. Throughout the discussion there was ample confirmation of this statement, although in many instances of an indirect character—wide variations in the temperatures used by different manufacturers for drying identical materials.

This was the fourth open conference called by U. S. Institute for Textile Research for the purpose of analyzing important textile problems, and learning whether scientific research was needed for their solution and would be likely to produce worthwhile results. Two of the previous conferences resulted in research projects now being conducted: One at Massachusetts Institute of Technology by U. S. Institute on warp sizing, and the other on rayon creping by the Throwsters Research Institute and the American Association of Textile Chemists and Colorists.

There was ample evidence brought out at this conference that some manufacturers, as a result of their own experimental research, are not only producing an improved product, but are getting these results in some cases at a reduced drying cost, or at costs only slighly higher than previously. In some cases it had been found that higher temperatures at higher speeds would give a better conditioned product; while in other cases materials could be dried at lowered temperatures and increased speeds with a better conditioned dried product. There was general agreement that textile drying is an extremely complicated process, and that results of scientific study of drying conditions that will preserve the natural properties of the fibers should prove a worthwhile project. U. S. Institute's Research Council will meet in the near future to decide upon what action will be taken on the results of this conference.

• SANDOZ RELEASES

Sandoz Chemical Works has released bulletins on the following new products:

Diazamine Orange 3RS—a bright shade of developed orange said to be of interest both for rayon and cotton. It is said to be white dischargeable and to be particularly good for the alkaline discharge, used on developed colors. Instructions for dyeing and alkaline discharge are given. Sample swatches of direct and developed dyeings and alkaline discharges are shown on rayon crepe and cotton piece goods.

Diazamine Browns—A bulletin showing samples of direct dyeings, developed dyeings and alkaline discharges of three diazamine browns: RB, 3RA and 6RA. They are white dischargeable and it is stated that the alkaline discharge, used on developed colors, is particularly good. Directions for dyeing and for the alkaline discharge are given.

• SAILED ON HINDENBURG

A. G. Watt, president of the A. G. Watt Company of Cleveland, representatives of the National Oil Products Company and Metasap Chemical Company, both of Harrison, N. J., sailed for Europe on the Hindenburg on its initial voyage from this country to Germany on Monday, May 11th, 1936.

• ELECTRIC GUIDERS

H. W. Butterworth & Sons Company, who for more than twenty years have made air operated guiders, exclusively, have announced that they will now market electrically operated guiders. It has been rumored in the trade for a few years past that Butterworth was experimenting with electric guiders; however, the announcement that these guiders were ready for the market was not made until recently.

The new electric guiders are described as being motor operated and having a contact switch which requires thirty grams to operate. The switch operates in a vacuum, and is said to be good for 100,000,000 operations. The make and break mechanism of the switch require a movement of less than one-fiftieth of an inch.

In speaking of their new electric guider, J. Ebert Butterworth, executive vice-president of the company, said: "Our experiments with electric guiders go back probably ten years, during which time we have

tried out practically every type of electromagnet, solonoid and contact switch. At least 20 different models have been made. We finally decided that we could use a motor for this work provided that a contact could be developed which would stand up for years without the need for replacement. Our specifications for the motor, too, were severe. Because of probable carelessness in neglecting to turn off electrical apparatus, we required that motors must be able to stand in stalled position for at least 30 hours with full current on. At the same time, the motors must be fully enclosed for wet work, and must be of a type which did not have brushes or armature windings. Brushes would wear out in time, and armature windings might burn out—especially if the motor were to be left in stalled position for several hours.

"Our specifications for motors were finally met, and work on the contact was proceeding satisfactorily. It was our desire to use the brass and rubber roller principle which had proven so satisfactory in our air guiders. These guiders usually operate best at about 15 pounds air pressure. This is sufficient to nip the cloth the second that it gets out of line.

"In our new guiders, we felt that if possible, we should improve over air guiders by allowing the operator to vary the pressure of the nip instantly if necessary. We also felt that some arrangement should be made to take care of seams as they passed through the rolls. Both of these features are incorporated in our new electric guiders.

"It was also our feeling that since we had marketed thousands of air operated guiders, that these should not be made obsolete by our electric guider. With this idea in mind, we designed our new guider so that by drilling of four holes, any of our guiders could be changed over to electric guiders.

"Naturally, before offering the new electric guiders to the trade, we tried them out on voiles, organdies, khaki and heavy duck. The results of these tests surprised even us. The cost of their operation averages but five cents for ten hours, and their maintenance cost for an equivalent of 34 months, has been but ten cents."

• NEW LAUNDERING PROCESS

Of interest to commercial laundry owners and their customers is a new laundering procedure recently announced by the du Pont Company under the name of the "Albone" Process. It is an adaptation of practices that have been followed for years in textile finishing for production of more permanent white and clearer colors. As in textile processing, the use of Albone (du Pont hydrogen peroxide) is involved.

A number of large commercial laundries have already adopted the process and are said to be enthusiastic about the results. It is to be discussed in the near future at a number of laundry association conventions and is said to have attracted the attention of technical men who are directly or indirectly connected with laundry work.

No radical changes in washroom practice nor any new equipment is required. It is claimed that the process is simple and safe for all classes of fabrics, white, solid, or part colored—silks, wools, cottons, linens, acetates, rayons, and mixtures. Formerly many of these fabrics could be washed only with soap and water.

Some of the features claimed for washings that go through the Albone process are clarified and brighter colors, better and more permanent whites, no linting of table linens, sweet, clean odor, efficient stain removal and high retention of fabric strength.

It is stated that the mild but effective cleansing action of peroxide and the absence of any grey-yellow color on fabrics processed with it have long been known. The problem was to adopt its use to conditions encountered in laundry work. How successfully this has been handled is indicated by the practical results already obtained by the laundries now employing the Albone process.

The inconvenience and hazards involved in the use of ordinary bleach are said to be eliminated, and Albone is further said to be less destructive to laundry equipment, particularly nets. There are no injurious residues—oxygen and water are formed by the decomposition. It is claimed that laundrymen have found that rinsing is much simplified and that less bluing and acid for scouring are required than with the usual bleach.

• ACID-RESISTANT PAIL

A new pail for handling the corrosive acids and alkalies in the textile industry has just been developed and tested out by the Dewey & Almy Chemical Co.

This new pail is cast from liquid latex compounded to withstand ageing and the action of corrosive chemicals. It is claimed that tests conducted show that the pail is resistant to such chemicals as glacial acetic acid, hydrochloric acid, 50° sulfuric acid, caustic soda, 17 per cent bleach water, formaldehyde, etc. A comprehensive chart prepared by the company shows the effect of various acids, alkalies, oxidizing and reducing agents, and metallic salts after immersion for 24-hour and 200-hour periods.

The heavy rubber prevents appreciable bulging, the makers state, and the front is reinforced so that it is possible to rest the pail on the edge of a tank when pouring without danger of collapsing it. A specially designed spout enables the user to control accurately the size of stream poured. A stainless steel bail reinforces the top and gives rigidity where needed, and is removable to save replacement costs.

• A.I.C. OFFICERS

The American Institute of Chemists announces the election of the following new officers and councilors:

President, Maximilian Toch, president of Toch Brothers; vice-president, Robert J. Moore, development manager, Bakelite Corporation; secretary, Howard S. Neiman, patent attorney; treasurer, Burke H. Knight, senior partner, Knight & Clarke.

Councilors: Frank G. Breyer, partner, Singmaster & Breyer; Neil E. Gordon, professor, chemical education, Johns Hopkins University; Allen Rogers, head of the department of chemical engineering, Pratt Institute.

• GEIGY RELEASE

Geigy Company, Inc. announces release of the following sample card:

Diazotized and Developed Colors—concerned with instructions for dyeing, diazotizing and developing of the Diazophenyl Colors. A table indicating the fastness properties of each of the colors is also included. These colors can be applied to all types of cotton goods and rayon, whether in the form of raw stock, yarn or piece goods. In general, it is stated, they have good solubility and dye level, for which reason they can be used to advantage in the average dyeing machine. They are particularly recommended by the manufacturers for their fastness to washing, in which respect, it is claimed, they are rated above the well-known and more easily applied direct colors. It is further stated that, with few exceptions, these colors have good dischargeability. It is pointed out that whereas Diazophenyl colors as a group can hardly be regarded as possessing exceptionally good fastness to light, this is usually overlooked as these colors are selected when the demand calls for shades of considerable depth, with good wash fastness properties. Color Card No. 267-D.

• du PONT RELEASES

The Dyestuffs Division of E. I. du Pont

de Nemours & Company has recently placed on the market the following: *Celanthrene Fast Violet BL*—a new acetate fiber dye which produces brilliant bluish shades of violet on acetate fiber yarn and piece-goods. The dyeings of this color are said to be very resistant to dry cleaning, light, and sea salt, and to possess satisfactory fastness to cold water spotting. It is therefore recommended by the manufacturers for dyeing acetate fiber dress-goods, draperies, and decorative fabrics which must be fast to these destructive agencies. It is said to exhibit good application properties and may be used alone as well as in combination with other colors of this type.

"Acetamine" Rubine B also a new addition to the du Pont line of acetate fiber dyestuffs, gives dark red shades on all types of acetate fiber materials and exhibits very good tinctorial strength. "Acetamine" Rubine B is said to be very fast to chlorine, dry cleaning, light, washing, and sea salt, and to be easy to apply, penetrating and leveling well. It should find use in self shades as well as in combination for solid color work and as a base for discharge patterns, as it is said to yield both good white discharge prints and straight dyeings of satisfactory general fastness.

"Celanthrene" and "Acetamine" are registered trade-marks of E. I. du Pont de Nemours & Company, Inc.

• 37TH ANNUAL REUNION, L. T. I.

The 37th Annual Reunion of the Lowell Textile Institute Alumni Association will be held on Saturday, June 6th, at the Institute in Lowell, Massachusetts. Included in the program will be exhibits of new apparatus, machinery and processes to be explained and demonstrated by the instructing staff; lunch; business meeting; dedication of new campus gate by the class of 1936; baseball game; golf; dinner; all alumni are also invited to attend a meeting of the Lowell Textile Institute Alumni Athletic Association, a new organization, to be held at 11:00 A.M.

A number of members of the alumni association are planning to make the trip to Lowell in groups; the members of the New York chapter are leaving on the Eastern Steamship Lines on Friday evening, June 5th, at 5:30 P.M.

OPEN FORUM

New Question

36—I would appreciate a method in which to overcome sleaziness in chiffon silk hosiery, if any.—**J. L. P. W.**

Unanswered Questions

27—Is there any satisfactory method for detecting the presence of sulfur black on a dark blue dyed fabric when a small amount of sulfur black has been added to the sulfur blue to deepen the shade?—**P. B. M.**

28—I am in need of some information in regard to the dyeing of cotton ducks with vat dyes. The method I am using is the regular pigment pad method, reduction being carried out subsequently in jigs. In padding 8 oz. and 10 oz. army ducks what density top and bottom padder rolls would be best adapted? Our pad rolls at present are bottom, 20 plastometer, top, 70 plastometer. We have found that equal density rolls give a shading from face to face. The face next to bottom roll being much darker under this condition. Should this fabric pass under and immersion roll in the pad box before entering the nip, or will the method used on light weight goods, passing the cloth directly into the nip having the bottom padder roll partially immersed in the pad box and a spray pipe on the top surface to feed the dye liquor, be best adapted to this type of fabric?—**A. M. L.**

33—I will appreciate advice and suggestions regarding the treatment of white cotton batting put up in wrapped loose rolls, sold to dry goods stores and others for "home-made-quilt" fillers.

The cotton is a high grade card waste, new, thoroughly clean and has the natural color tinge.

I would like to give it a slight or very mild bleach to whiten it a bit, and would like a process which is generally considered best and safest for cotton of this type and that will tender it the least.

Are there any gas bleach products for cotton on the market?

Have you any information as to the use of "Ozone Gas" for bleaching and is such a product being manufactured?

The bleaching needs to be economical and not necessarily perfect for this type of material.

We are further interested in the method of mechanically handling this material during the bleaching process.—**H. A. H.**

34—We are interested in obtaining what is known as a Mousseline de Soi permanent finish on chiffons and marquisettes.

The solution must be one that will not mark off and that can be applied either through a quetch or by immersion.—**B. P. D. W.**

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: By salesman who covered Philadelphia territory on oils, finishes, soaps, tints and dyes. Available at once. Write Box No. 903, American Dyestuff Reporter.

WANTED: Chemist, recent college graduate with one or two years experience or experienced during school vacations in a textile bleaching, finishing or printing plant. State age, height, weight, salary desired, training and experience. Send photograph. P. O. Box 1576, Charlotte, N. C.